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# DRAG COEFFICIENTS FOR IRREGULAR FRAGMENTS

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RESEARCH AND TECHNOLOGY DEPARTMENT
AND DEPARTMENT OF DEFENSE
EXPLOSIVES SAFETY BOARD

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Drag coefficients for irregular fragments were determined for 96 fragments in a vertical wind tunnel at Mach numbers of approximately 0.1. Correlation of drag coefficient with the maximum-to-average presented area ratio is presented. A method for approximating the whole drag curve is also given. Physical characteristics, photos, and wind tunnel test results are given in the appendixes. Keywords;




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# FOREWORD

The work on fragment drag coefficients contained in this report is part of a continuing effort for the Department of Defense Explosives Safety Board (DDESB). In addition to testing, the Naval Surface Warfare Center (NSWC) is tasked with establishing analytical techniques for predicting the hazards from fragments produced by the inadvertent detonation of ordnance stacks.

All tests and data reduction for this report were directed by the author while an employee of NSWC. This documentation was done by the author while an employee of Kilkeary, Scott and Associates, Inc.

The wind tunnel tests and data reduction were conducted by the Aerodynamics Research and Concepts Assistance Branch, Research Directorate, U.S. Army Chemical Research, Development and Engineering Center, Aberdeen Proving Ground, Maryland. The author acknowledges the following personnel of the Aerodynamics Research and Concepts Assistance Branch: Miles C. Miller; Richard R. Raup; Owen C. Smith, Jr.; and Daniel J. Weber. Deborah Rollins and Rose Baker of NSWC performed the fragment presented area measurements. Rose Baker made the linear measurements of the fragments and made all necessary calculations and graphical plots. Stephen F. McCleskey derived the equations for maximum presented area and the variance of the presented areas for a given fragment modeled as a rectangular parallelepiped.

This report has been reviewed by W. H. Bohli, Head, Explosion Dynamics Branch.

Approved by:

K. F. MUELLER, Head
Energetic Materials Division

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# INTRODUCTION

The Naval Surface Warfare Center (NSWC) has a continuing task from the Department of Defense Explosives Safety Board (DDESB) to establish methods for predicting the fragment hazards due to the inadvertent explosion of ordnance items. As part of this task, NSWC has established a computer model,[1] which predicts fragment hazards for specified targets.

The computer model calculates individual trajectories for each fragment recovered in small-scale fragmentation arena tests. The following variables affect the flight dynamics of a fragment which is modeled as a point mass: gravity, velocity, area to mass ratio, air density, wind speed, and drag coefficient.

Except for the drag coefficient, all of these variables can be established with a fair degree of accuracy by tests, measurements and calculations. The drag coefficient for any fragment is a function of shape only. For regular fragments, like spheres and cubes, the drag coefficients are reasonably well-defined. For irregular fragments, like those from bombs or concrete walls, no two fragments have exactly the same shape. As a result, no two irregular fragments have exactly the same drag coefficient. Additionally, drag coefficient is a function of Mach number.

The uncertainty of drag coefficients for irregular fragments produces an associated uncertainty in far-field impact range. Figure 1 shows range versus low subsonic drag coefficient ($C_D$) for a typical fragment trajectory. The initial elevation angle, average presented area to mass ratio, and initial velocity are shown in Figure 1. The range of low subsonic $C_D$ varies from 0.5 to 1.5, a factor of three. The associated ranges vary by a factor of more than two. This represents a large range of uncertainty in the trajectory calculations for establishing fragment hazards for use in quantity-distance determinations. If this uncertainty is to be reduced, some correlation must be established between drag coefficient ($C_D$) and the characteristics of irregular fragments.

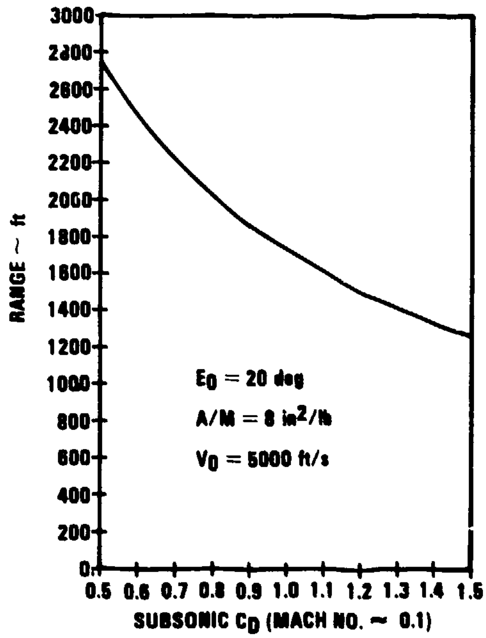



FIGURE 1. $C_D$--RANGE SENSITIVITY

Since $C_D$ is a function of shape only, any correlating parameter must be dimensionless; i.e., geometrically similar fragments that have the same drag coefficient should have the same value for the correlating parameter. For example, the ratio of maximum to minimum presented area might be used as a measure of shape. This ratio would be dimensionless. For a sphere, this ratio would always be one no matter what the size or material of the sphere. For a cube, this ratio would always be 1.732.

The impetus for this program was provided by an observation of the data contained in one of the first systematic reports on drag coefficients for irregular fragments.[2] Three regular fragments were studied in the report; i.e., a sphere, a cube, and a bar. The bar length, width, and thickness were in the ratio of 5:1:1. Since these fragments were regular, exact ratios of maximum to minimum presented area could be calculated. The results, at a Mach number of about 0.75, were as follows:

| | Sphere | Cube | Bar |
|---|---|---|---|
| $C_D$ (AVG) | 0.60 | 0.88 | 1.12 |
| $A_{MAX}/A_{MIN}$ | 1.00 | 1.73 | 7.14 |

Note that as the correlation ratio increases so does the $C_D$. The report also shows that the average $C_D$ for irregular fragments was greater than those for the sphere or cube. For most irregular fragments, the area ratio could be expected to be on the order of that for the bar. Everything seemed to support the idea that the $C_D$ for irregular fragments could be correlated with dimensionless parameters.

## DRAG COEFFICIENT PROGRAM

### FRAGMENT SELECTION

Ninety-six fragments were selected to provide a wide range of shapes to ensure a good statistical sample. In all cases, the fragments were made of steel. Photographs of each fragment are contained in Appendix B. The fragments were recovered from the detonation of the following ordnance items:

1. 155mm M107 projectile
2. 76mm Mk 165 projectile
3. Mk 84 low drag bomb
4. Mk 82 low drag bomb

The matchup between ordnance item and fragment is given in Table A-2 of Appendix A under the heading SOURCE.

### FRAGMENT MEASUREMENTS

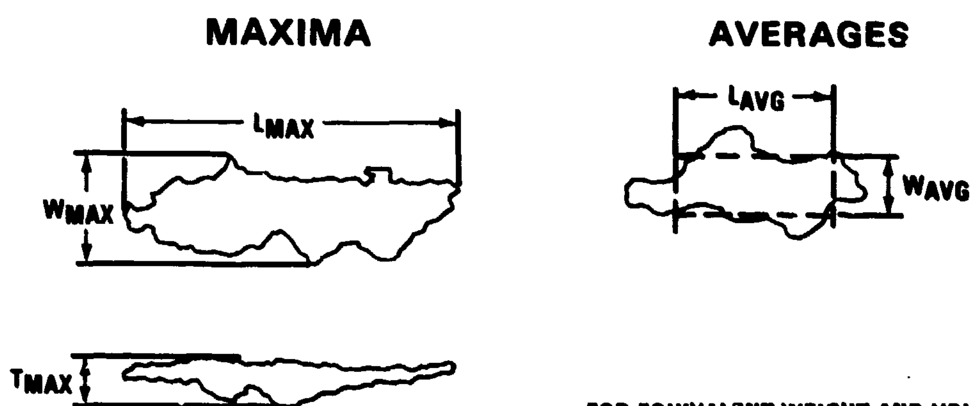
Five different kinds of measurements were made for each fragment:

1. Linear maximum length (L), width (W), and thickness (T),

2. Linear average L, W, and T,
3. Perimeters in the three coordinate planes,
4. Presented areas:
   a. maximum
   b. average
   c. minimum
   d. variance
   e. standard deviation
5. Moment of inertia (three axes)

Linear dimensions were measured as shown in Figure 2. Note that in measuring average dimensions, the average thickness is calculated to produce an equivalent weight and volume rectangular parallelepiped. Maximum and average dimensions for all fragments are contained in Table A-2 of Appendix A. The convention for L, W, and T is as follows:

$$L \geq W \geq T$$




FOR EQUIVALENT WEIGHT AND VOLUME

$$T_{AVG} = \frac{WT}{L_{AVG} \cdot W_{AVG} \cdot \rho}$$

WT = FRAG WEIGHT (lb)

$L_{AVG}$ = AVERAGE LENGTH (in.)

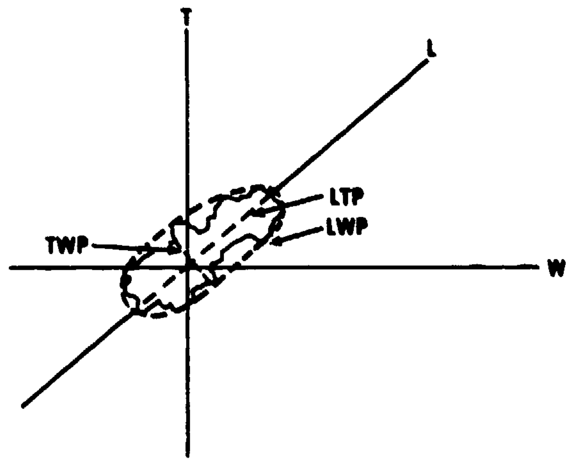
$W_{AVG}$ = AVERAGE WIDTH (in.)

$\rho$ = FRAG DENSITY (lb/in.$^3$)

$\rho$ = 0.28 (STEEL)

FIGURE 2. FRAGMENT LINEAR DIMENSIONS

Perimeters were measured in three planes as shown in Figure 3. Note that the perimeters do not follow the jagged contour of the fragment. In fact, the measurements were made by stretching a string around the fragment in each of the three mutually perpendicular planes. The perimeter measurements for all fragments are shown in Table A-2 of Appendix A.




LWP - PERIMETER IN L-W PLANE

LTP - PERIMETER IN L-T PLANE

TWP - PERIMETER IN T-W PLANE

FIGURE 3. PERIMETER MEASUREMENTS

Fragment presented areas were measured in two ways. First, measurements were made using an Icosahedron Gage and second, calculations were performed using equivalent weight and volume rectangular parallelepipeds. The parallelepipeds were constructed using the average linear dimensions discussed above. Figures 4 and 5 show the essentials of these measurements and calculations. The Icosahedron Gage is an electro-optical device which throws a shadow of a fragment onto a sensing surface. The associated electronics produce a readout of presented area. The optical axis is positioned at 16 approximately equally spaced aspects so as to produce 16 distinct presented areas. The Icosahedron Gage cannot mount a fragment weighing more than 1500 grains. For larger fragments, presented area statistics were calculated using rectangular parallelepipeds as shown in Figure 5. The Icosahedron Gage presented areas for the first 84 fragments are given in Table A-1 of Appendix A. The minimum, maximum, average, standard deviation, and variance of the presented areas, calculated from the rectangular parallelepipeds, are given in Table A-3 of Appendix A.

The weight moments of inertia[3] for rectangular parallelepipeds are as follows:

$$I_T = \frac{M(L^2+W^2)}{12}$$

$$I_W = \frac{M(L^2+T^2)}{12}$$

$$I_L = \frac{M(W^2+T^2)}{12}$$

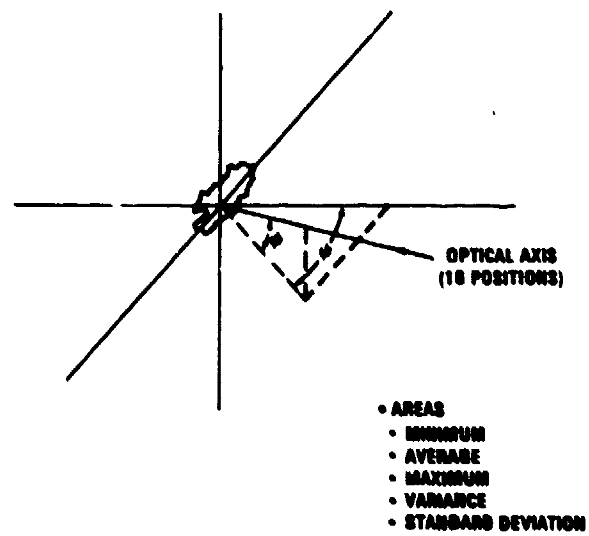
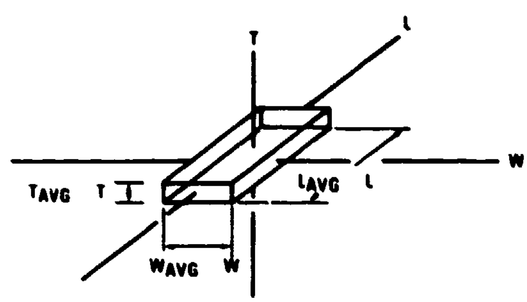



FIGURE 4. PRESENTED AREA MEASUREMENTS
(ICOSAHEDRON GAGE)




AREAS

MINIMUM $= W \bullet T$

AVERAGE $= 0.5\,(L \bullet W + L \bullet T + W \bullet T)$

MAXIMUM $= ((L \bullet W)^2 + (T \bullet L)^2 + (T \bullet W)^2)^{1/2}$

VARIANCE $= 1/12\left[(L \bullet T)^2 + (W \bullet T)^2 + (L \bullet W)^2\right] + \left[4/(3\pi) - 1/2\right] \bullet \left[L \bullet W \bullet (T)^2 + T \bullet W \bullet (L)^2 + T \bullet L \bullet (W)^2\right]$

STANDARD DEVIATION $=$ (VARIANCE)$^{1/2}$

FIGURE 5. PRESENTED AREA MEASUREMENTS
(EQUIVALENT WEIGHT AND VOLUME RECTANGULAR PARALLELEPIPED)

where

$I_T$--moment of inertia about T axis

$I_W$--moment of inertia about W axis

$I_L$--moment of inertia about L axis

M--weight of fragment (grains)

L--average length (in.)

W--average width (in.)

T--average thickness (in.)

The weight moments of inertia are given in Table A-7 of Appendix A.

## VERTICAL WIND TUNNEL

The vertical wind tunnel used for this program is located at the U.S. Army Chemical Research, Development and Engineering Center in Aberdeen, Maryland. The Aerodynamics Research and Concepts Assistance Branch of the Research Directorate operates the vertical wind tunnel.

The essential aspects of the vertical wind tunnel are shown in Figure 6. In operation, a fragment is placed on the fragment support screen in either the upper or lower test section depending on the air velocity necessary to raise the fragment. The air speed is controlled by opening or closing the inlet vanes of the constant speed fan. The air speed is adjusted until the fragment rises from the screen and assumes relatively stable vertical equilibrium. At this time, the air stream velocity is read directly from the velocity calibrated manometer. Air density is calculated from the ambient pressure and temperature. Ambient conditions are acceptable because of the relatively low air velocities produced in the tunnel. These parameters together with the weight and average presented area of the fragment are then used to calculate the low subsonic drag coefficient ($C_D$).

Each fragment was tested in the vertical wind tunnel. The velocity of the air stream was increased until the fragment hovers at a near constant vertical height. In this vertical equilibrium position, the drag and gravity forces will be equal. From the wind tunnel, the velocity of the air stream is established. Air density ($\rho$) is established from ambient pressure and temperature. The average presented area (A) of the fragment is obtained from measurements discussed above. As shown in Figure 7, once we know these values, we can calculate $C_D$. Since we operate at a single air velocity for each fragment, we can only obtain a single point on the drag curve. This point is in the low subsonic region, roughly about a Mach number of 0.1. The remainder of the drag curve must be inferred from other sources.

## RESULTS

The test record for each fragment is contained in Appendix C. Each record gives three views of the fragment. These views in conjunction with the photographs of Appendix B give a good indication of fragment shape. The L, W, and T axes are shown. Remember that the convention for L, W, and T is:

$$L \geq W \geq T$$

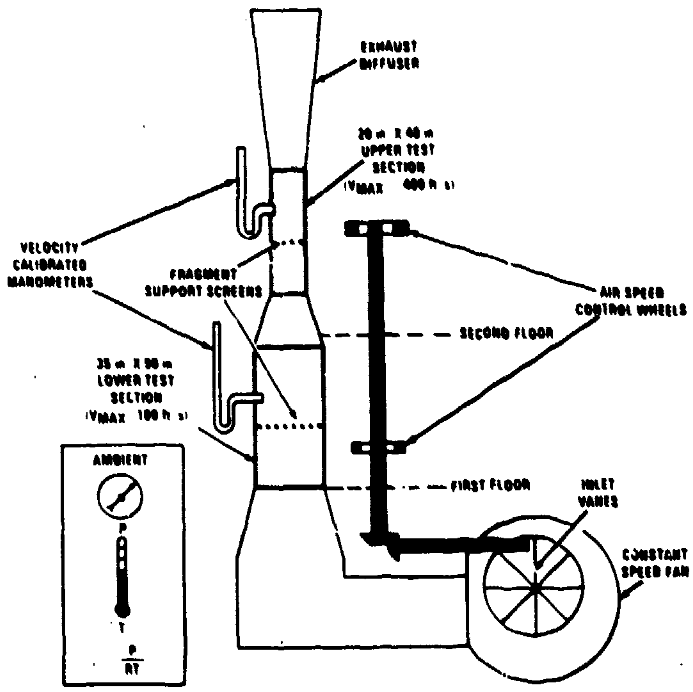
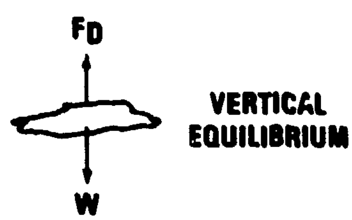



FIGURE 6. SUBSONIC VERTICAL WIND TUNNEL




$$F_D = \text{DRAG FORCE} = \frac{C_D \rho A V^2}{2}$$

$$W = \text{FRAG WEIGHT}$$

$$F_D = W = \frac{C_D \rho A V^2}{2}$$

$$\boxed{C_D = \frac{2W}{\rho A V^2}}$$

FIGURE 7. EXPERIMENTAL DRAG COEFFICIENT

The calculated $C_D$ is shown on the test records along with the values of the variables necessary for the calculation. Remarks for each test are given that include the motion of the fragment in the vertical wind tunnel.

Tables A-4, A-5, A-6, and A-7 of Appendix A list all the dimensionless ratios considered for correlation with the low subsonic $C_D$. Ratios containing the minimum presented area were not used because of the errors inherent in the Icosahedron Gage. This is explained in the notes on Table A-3 at the beginning of Appendix A. Correlations were attempted using the dimensionless ratios singly and in pairs. When considering pairs of dimensionless ratios, the object was to draw lines of constant value for the second ratio within the uncertainty obtained with the first ratio and thus refine the correlations. In all cases, the lines of constant value plotted vertically and yielded no additional information. The second ratios were always dependent on the first ratios. When all plots were completed, the best correlation was obtained with the ratio of maximum to average presented area ($A_{max}/A_{avg}$). The correlation plot is shown in Figure 8.

Figure 8 shows the plotted points for the 96 fragments and the maximum and minimum boundary lines and their equations. The three fragments used as a baseline (sphere, cube, and bar) are identified. The value for $A_{max}/A_{avg}$ is an average of the values obtained using the icosahedron gage and the equivalent rectangular parallelepipeds. The total range of $C_D$ uncertainty for all irregular fragments is about 1.0; i.e., from 0.5 to 1.5. The range of uncertainty at an average $A_{max}/A_{avg}$ of about 1.5 is approximately 0.6. On average then, it can be said that the correlation reduces $C_D$ uncertainty by about 40 percent. In order to reduce range uncertainty to about $\pm 10$ percent, it would be necessary to reduce the $C_D$ uncertainty by about 75 percent.

The three regular fragments (sphere, cube, and bar) tested by Dunn and Porter[2] gave $C_D$ values in the high subsonic region at Mach numbers of approximately 0.75. In the vertical wind tunnels tests, the Mach numbers were nearer 0.1. $C_D$ values for the three baseline fragments are compared at the two Mach number levels in Table 1.

TABLE 1. COMPARISON OF BASELINE FRAGMENTS

| | $C_D$ Wind Tunnel ($M \approx 0.1$) | $C_D$(AVG) Dunn and Porter ($M \approx 0.75$) | Delta |
|---|---|---|---|
| Sphere | 0.42 | 0.60 | + 0.18 |
| Cube | 0.64 | 0.88 | + 0.24 |
| Bar | 0.94 | 1.12 | + 0.18 |

As seen in Table 1, $C_D$ at Mach 0.75 is about 0.2 higher then $C_D$ at Mach 0.1 for all three fragments. Owing to the consistency in the rise of $C_D$ from Mach 0.1 to 0.75 for the three regular fragments, it seems reasonable at this time to accept the same rise in $C_D$ for irregular fragments. In this way, the shape of the subsonic drag curve for irregular fragments is established. This is important because range is more sensitive to changes in subsonic $C_D$ than to similar changes in supersonic $C_D$. This is demonstrated in Figure 9 where velocity is plotted against range ratio for a typical farfield fragment trajectory. The range ratio is the fraction of the total trajectory range traversed. From Figure 9 it can be seen that only 25 percent of the trajectory is supersonic while 75 percent is subsonic. The next point to consider is fragment motion in the wind tunnel.

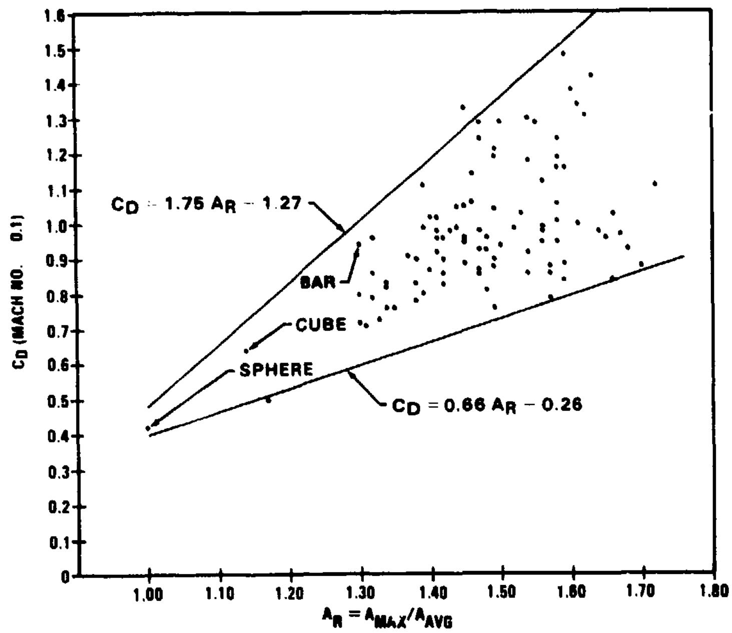



FIGURE 8. DRAG COEFFICIENT ($C_D$) VERSUS PRESENTED AREA RATIO ($A_R$)

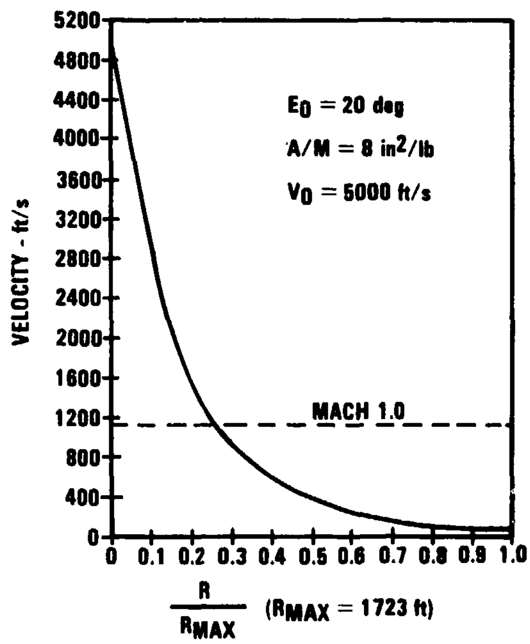



FIGURE 9. VELOCITY VERSUS RANGE RATIO

Each test record in Appendix C describes fragment motion in the vertical wind tunnel at near vertical equilibrium. In a further attempt at correlation, the 96 motions were divided into eight categories of typical motion. The eight categories and their associated fragments are shown in Figures D-1 through D-8 of Appendix D. No systematic correlation was discovered. One surprise, however, was observed. Only about one-third of the fragments tumbled randomly in the wind tunnel. This is contrary to the traditional assumption that all irregular fragments tumble randomly in flight. It was because of this assumption that $C_D$ for each fragment was calculated using the average presented area. Had a larger presented area (A) been used for fragments which exhibited a motion such as flat rotation, then a smaller $C_D$ would have been calculated. Similarly, a smaller presented area (A) would have produced a larger $C_D$. In practice, it is only necessary that the $C_D \bullet A$ product be the same for the test and the trajectory calculation. Again, this knowledge did not yield any systematic correlation. It must also be borne in mind that the motion of a fragment at low subsonic velocities may differ from the motion of supersonic velocities because of such factors as shock waves.

## USING THE LOW SUBSONIC DRAG COEFFICIENT TO CALCULATE FRAGMENT TRAJECTORIES

The low subsonic drag coefficient obtained from the vertical wind tunnel tests is only one point on the drag curve. To draw an entire drag curve, points must be inferred from other sources. The current state of knowledge about drag coefficients for irregular fragments does not warrant a complex curve. A series of straight line approximations is sufficient at this time. Using data from previous drag reports,[2,4] transonic and supersonic pivot points can be approximated. From the RESULTS section, we have shown a 0.2 rise in $C_D$ from Mach 0.1 to 0.75. Table 2 shows the points necessary to define straight line approximations to the drag curve for any fragment.

TABLE 2. APPROXIMATION OF STRAIGHT LINE POINTS

| Point | Point Name | Mach No. | $C_D$ |
|---|---|---|---|
| D1 | Anchor | 0.10 | D1 |
| D2 | Pivot #1 | 0.75 | D1 + 0.20 |
| D3 | Pivot #2 | 1.50 | D1 + 0.65 |
| D4 | Pivot #3 | 2.50 | D1 + 0.50 |

The points and straight line approximations are shown in Figure 10. Note that above Mach 2.5, $C_D$ is considered constant. The anchor point is taken from Figure 8 for a particular $A_{max}/A_{avg}$ at Mach 0.10. Once the anchor point is determined then all the straight line approximations are defined. This results in the straight line approximations for all fragments being parallel to one another. Although exact parallelism would hardly be the case in all instances, there are grounds for the assumption. The Dunn and Porter report[2] shows that the drag curve for spheres is essentially parallel to the drag curve for long rectangular parallelepipeds and shell fragments. The drag curve for cubes and cylinders ($L/D = 1$) is parallel to the previous two except for a small discrepancy in the transonic region.

The anchor point may be selected in a variety of ways. For a particular fragment with a given $A_{max}/A_{avg}$, the anchor point may be selected anywhere within the uncertainty defined by the upper and lower boundary lines of Figure 8. The anchor point could be an average, a maximum, a minimum, or an intermediate value. It could also be chosen by random selection within the boundary lines.

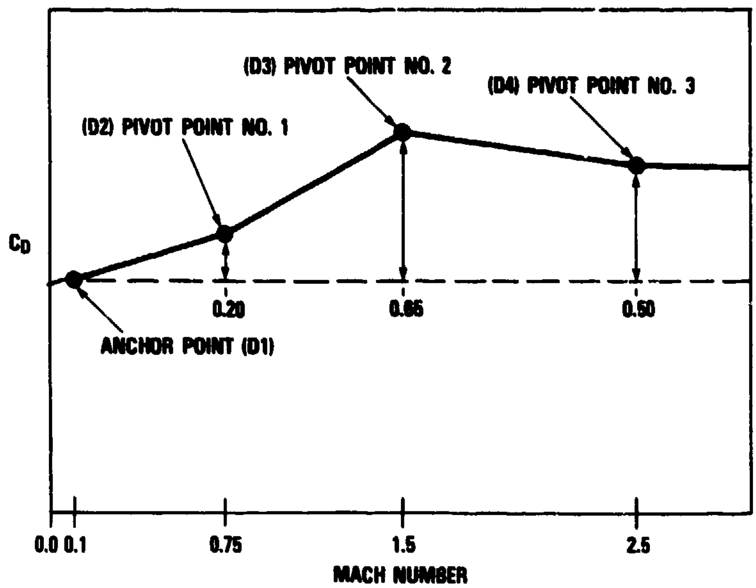



FIGURE 10. STRAIGHT LINE APPROXIMATION TO FRAGMENT $C_D$ CURVES

The following equations for air density and Mach number may be of help in using fragment drag coefficients.

$$\rho = 0.0765\, e^{-\left(\frac{A}{33900}\right)}$$

where

$\rho$ = air density (lb/ft$^3$)
A = altitude (+) above sea level and (-) below sea level (ft)

$$M = \frac{V_F}{V_S}$$

where

M = Mach number
$V_F$ = velocity of fragment
$V_S$ = velocity of sound

$$V_S = 1116.4\, e^{-\left(\frac{A}{286000}\right)}$$

where

$V_S$ = velocity of sound (ft/sec)
A = altitude (+) above sea level and (-) below sea level (ft)

## FUTURE CONSIDERATIONS

Significant problems remain unresolved. For an acceptable range uncertainty of about ±10 percent, it will be necessary to reduce $C_D$ uncertainty by about 75 percent. The work to date has only reduced the $C_D$ uncertainty by about 40 percent. This additional reduction in $C_D$ uncertainty might be accomplished in a variety of ways. More efficient correlation parameters might be established. The typical motion of the fragments in the vertical wind tunnel (Figures D-1 through D-8 of Appendix D) might be used as an added correlation provided the motion could be predicted based on the physical characteristics of irregular fragments. Possibly, the use of presented areas other than the average might be used in calculating $C_D$.

Another unresolved problem involves the shape of the transonic and supersonic portions of the drag curve. It would be a help if a practical method for testing irregular fragments could be established for a supersonic wind tunnel. Possibly, some sort of gimbal device could be designed which would allow the fragment to move freely and, at the same time, continually measure drag force. Such a device might be calibrated by using spheres or cubes for which drag curves are fairly well known.

## REFERENCES


1. McCleskey, Frank, *Quantity-Distance Fragment Hazard Computer Program (FRAGHAZ)*, Naval Surface Warfare Center TR 87-59, February 1988.

2. Dunn, D. J. and Porter, W. R., *Air Drag Measurements of Fragments*, BRL Memorandum Report No. 915, August 1955.

3. Myers, Jack A., *Handbook of Equations for Mass and Area Properties of Various Geometrical Shapes*, NAVWEPS Report 7827, April 1962.

4. Daniels, P., et al., *Subsonic, Transonic and Supersonic Drag Characteristics of Nine Shape Categories of Warhead Fragments*, Naval Surface Warfare Center TR 81-112, May 1981.

# APPENDIX A

## TABLES OF FRAGMENT CHARACTERISTICS

These tables contain dimensional characteristics for all 96 fragments. Additionally, they contain the dimensionless ratios used for correlation with the drag coefficients calculated from vertical wind tunnel tests. The following comments are made to the seven tables:

Table A-1 - This table contains the 16 presented areas measured by the Icosahedron Gage for the first 84 fragments. The last 12 fragments were too heavy to mount on the gage. The presented areas have been sorted and listed in ascending order for each fragment.

Table A-2 - The weapon from which each fragment was taken is listed under SOURCE. Maximum and average length, width, and thickness are listed after the fragment weight in grains. The linear dimensions are described in Figure 2 of the DRAG COEFFICIENT PROGRAM Section. Perimeter as described in Figure 3 is listed next. Finally, the drag coefficient ($C_D$) obtained from tests in the vertical wind tunnel is listed.

Table A-3 - The minimum, maximum, and average presented areas are listed for each fragment. The standard deviation and variance of the presented areas are given next. Under each of the five headings, values are given based on Icosahedron Gage (ICOS) measurements, and calculations (CALC) based on equal weight and volume parallelepipeds as described in Figure 5 of the DRAG COEFFICIENT PROGRAM Section. Note the large differences in the ICOS and CALC values for minimum presented area. This is due to the inherent limitations of the Icosahedron Gage caused by its preset mechanical stops. In all cases, the minimum CALC values are more near the truth. The CALC value for fragment number 1, the bar fragment, is very accurate while the ICOS value is almost three times as big.

Table A-4 - Fragments are renumbered in accordance with ascending $C_D$. This is done to provide a quick picture of correlation. The OLD fragment number is the number assigned in Tables A-1 through A-3 and in Appendixes B, C, and D. Three dimensionless area ratios are given and values are given for both Icosahedron Gage measurements and parallelepiped calculations.

Table A-5 - Again, fragment drag coefficients ($C_D$) are listed in ascending order. All dimensionless ratio headings are explained at the end of the table.

Table A-6 - Here dimensionless perimeter ratios are given. Headings are explained at the bottom of the table.

Table A-7 - Weight moments of inertia and their associated dimensionless ratios are given. Weight moments of inertia are explained in the FRAGMENT MEASUREMENTS Subsection of the DRAG COEFFICIENT PROGRAM Section.

## TABLE A-1. PRESENTED AREA (SQ. IN.) (ICOSAHEDRON GAGE)

| FRAG NO. | PRESENTED AREA 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.198 | 0.210 | 0.274 | 0.284 | 0.311 | 0.323 | 0.323 | 0.326 | 0.340 | 0.357 | 0.367 | 0.397 | 0.406 | 0.405 | 0.409 | 0.433 |
| 2 | 0.785 | 0.785 | 0.785 | 0.785 | 0.785 | 0.785 | 0.785 | 0.785 | 0.785 | 0.785 | 0.785 | 0.785 | 0.785 | 0.785 | 0.785 | 0.785 |
| 3 | 0.638 | 0.687 | 0.805 | 0.809 | 0.827 | 0.854 | 0.888 | 0.890 | 0.890 | 0.893 | 0.920 | 0.932 | 0.944 | 0.952 | 0.976 | 0.983 |
| 4 | 0.192 | 0.229 | 0.236 | 0.242 | 0.278 | 0.288 | 0.293 | 0.296 | 0.306 | 0.307 | 0.311 | 0.338 | 0.339 | 0.353 | 0.359 | 0.365 |
| 5 | 0.171 | 0.240 | 0.245 | 0.270 | 0.280 | 0.290 | 0.359 | 0.373 | 0.393 | 0.408 | 0.418 | 0.443 | 0.452 | 0.492 | 0.536 | 0.576 |
| 6 | 0.157 | 0.216 | 0.228 | 0.247 | 0.247 | 0.256 | 0.270 | 0.276 | 0.304 | 0.311 | 0.339 | 0.361 | 0.361 | 0.376 | 0.376 | 0.412 |
| 7 | 0.197 | 0.203 | 0.237 | 0.243 | 0.249 | 0.256 | 0.290 | 0.291 | 0.309 | 0.312 | 0.327 | 0.366 | 0.373 | 0.388 | 0.399 | 0.412 |
| 8 | 0.183 | 0.213 | 0.247 | 0.271 | 0.274 | 0.291 | 0.355 | 0.360 | 0.367 | 0.404 | 0.426 | 0.475 | 0.475 | 0.526 | 0.551 | 0.580 |
| 9 | 0.183 | 0.190 | 0.283 | 0.285 | 0.307 | 0.315 | 0.327 | 0.334 | 0.337 | 0.401 | 0.401 | 0.401 | 0.435 | 0.476 | 0.476 | 0.496 |
| 10 | 0.230 | 0.240 | 0.262 | 0.271 | 0.328 | 0.340 | 0.367 | 0.391 | 0.438 | 0.445 | 0.570 | 0.573 | 0.580 | 0.585 | 0.622 | 0.700 |
| 11 | 0.201 | 0.217 | 0.257 | 0.267 | 0.275 | 0.288 | 0.292 | 0.316 | 0.337 | 0.360 | 0.404 | 0.407 | 0.413 | 0.416 | 0.434 | 0.486 |
| 12 | 0.214 | 0.222 | 0.226 | 0.240 | 0.256 | 0.270 | 0.277 | 0.290 | 0.336 | 0.358 | 0.385 | 0.385 | 0.443 | 0.455 | 0.484 | 0.510 |
| 13 | 0.206 | 0.231 | 0.239 | 0.240 | 0.245 | 0.260 | 0.260 | 0.269 | 0.280 | 0.296 | 0.303 | 0.310 | 0.320 | 0.349 | 0.353 | 0.355 |
| 14 | 0.190 | 0.266 | 0.278 | 0.278 | 0.290 | 0.298 | 0.303 | 0.339 | 0.347 | 0.357 | 0.366 | 0.374 | 0.400 | 0.442 | 0.445 | 0.457 |
| 15 | 0.222 | 0.237 | 0.266 | 0.276 | 0.300 | 0.303 | 0.325 | 0.335 | 0.337 | 0.349 | 0.389 | 0.396 | 0.400 | 0.425 | 0.442 | 0.457 |
| 16 | 0.206 | 0.236 | 0.329 | 0.359 | 0.379 | 0.383 | 0.388 | 0.423 | 0.423 | 0.438 | 0.472 | 0.492 | 0.522 | 0.546 | 0.561 | 0.566 |
| 17 | 0.210 | 0.239 | 0.295 | 0.327 | 0.330 | 0.337 | 0.337 | 0.349 | 0.359 | 0.413 | 0.432 | 0.454 | 0.467 | 0.496 | 0.506 | 0.552 |
| 18 | 0.247 | 0.257 | 0.294 | 0.311 | 0.313 | 0.316 | 0.374 | 0.401 | 0.404 | 0.421 | 0.423 | 0.423 | 0.445 | 0.453 | 0.475 | 0.521 |
| 19 | 0.213 | 0.225 | 0.252 | 0.255 | 0.267 | 0.308 | 0.330 | 0.345 | 0.348 | 0.372 | 0.414 | 0.443 | 0.473 | 0.477 | 0.480 | 0.517 |
| 20 | 0.223 | 0.296 | 0.343 | 0.360 | 0.377 | 0.399 | 0.424 | 0.436 | 0.443 | 0.487 | 0.500 | 0.519 | 0.522 | 0.522 | 0.544 | 0.617 |
| 21 | 0.200 | 0.296 | 0.308 | 0.313 | 0.382 | 0.391 | 0.416 | 0.421 | 0.462 | 0.480 | 0.612 | 0.639 | 0.641 | 0.649 | 0.668 | 0.744 |
| 22 | 0.281 | 0.350 | 0.380 | 0.410 | 0.410 | 0.434 | 0.508 | 0.538 | 0.577 | 0.622 | 0.632 | 0.641 | 0.676 | 0.701 | 0.704 | 0.804 |
| 23 | 0.272 | 0.339 | 0.341 | 0.373 | 0.380 | 0.412 | 0.437 | 0.451 | 0.468 | 0.471 | 0.498 | 0.508 | 0.510 | 0.591 | 0.598 | 0.613 |
| 24 | 0.265 | 0.275 | 0.275 | 0.290 | 0.299 | 0.400 | 0.400 | 0.441 | 0.444 | 0.464 | 0.593 | 0.603 | 0.618 | 0.630 | 0.640 | 0.745 |
| 25 | 0.260 | 0.262 | 0.407 | 0.409 | 0.429 | 0.431 | 0.458 | 0.505 | 0.508 | 0.519 | 0.612 | 0.637 | 0.678 | 0.701 | 0.784 | 0.794 |
| 26 | 0.294 | 0.355 | 0.367 | 0.441 | 0.455 | 0.470 | 0.495 | 0.509 | 0.539 | 0.610 | 0.615 | 0.615 | 0.634 | 0.720 | 0.749 | 0.764 |
| 27 | 0.339 | 0.353 | 0.424 | 0.446 | 0.473 | 0.505 | 0.515 | 0.522 | 0.539 | 0.547 | 0.571 | 0.640 | 0.642 | 0.696 | 0.740 | 0.745 |
| 28 | 0.333 | 0.364 | 0.421 | 0.445 | 0.475 | 0.477 | 0.480 | 0.536 | 0.536 | 0.558 | 0.565 | 0.614 | 0.644 | 0.666 | 0.697 | 0.751 |
| 29 | 0.351 | 0.361 | 0.390 | 0.417 | 0.437 | 0.468 | 0.523 | 0.530 | 0.542 | 0.559 | 0.562 | 0.572 | 0.606 | 0.630 | 0.670 | 0.692 |
| 30 | 0.295 | 0.329 | 0.348 | 0.429 | 0.432 | 0.454 | 0.503 | 0.530 | 0.537 | 0.554 | 0.579 | 0.581 | 0.606 | 0.633 | 0.669 | 0.735 |
| 31 | 0.344 | 0.379 | 0.393 | 0.408 | 0.411 | 0.418 | 0.423 | 0.440 | 0.477 | 0.494 | 0.528 | 0.531 | 0.536 | 0.536 | 0.540 | 0.570 |
| 32 | 0.289 | 0.487 | 0.501 | 0.531 | 0.536 | 0.546 | 0.590 | 0.620 | 0.659 | 0.679 | 0.699 | 0.699 | 0.730 | 0.768 | 0.792 | 0.812 |
| 33 | 0.360 | 0.365 | 0.400 | 0.439 | 0.439 | 0.458 | 0.458 | 0.471 | 0.478 | 0.478 | 0.500 | 0.510 | 0.547 | 0.576 | 0.591 | 0.596 |
| 34 | 0.313 | 0.491 | 0.496 | 0.526 | 0.536 | 0.565 | 0.565 | 0.587 | 0.594 | 0.609 | 0.611 | 0.697 | 0.732 | 0.744 | 0.832 | 0.842 |
| 35 | 0.312 | 0.322 | 0.410 | 0.489 | 0.499 | 0.598 | 0.608 | 0.627 | 0.716 | 0.765 | 0.825 | 0.854 | 0.889 | 0.894 | 0.907 | 1.047 |
| 36 | 0.361 | 0.391 | 0.393 | 0.464 | 0.518 | 0.545 | 0.582 | 0.592 | 0.599 | 0.631 | 0.677 | 0.697 | 0.758 | 0.795 | 0.859 | 0.986 |
| 37 | 0.300 | 0.432 | 0.444 | 0.447 | 0.523 | 0.572 | 0.599 | 0.599 | 0.621 | 0.643 | 0.667 | 0.709 | 0.743 | 0.748 | 0.812 | 0.853 |
| 38 | 0.349 | 0.349 | 0.371 | 0.425 | 0.459 | 0.501 | 0.501 | 0.508 | 0.569 | 0.594 | 0.633 | 0.653 | 0.670 | 0.692 | 0.721 | 0.787 |
| 39 | 0.418 | 0.467 | 0.477 | 0.494 | 0.536 | 0.587 | 0.665 | 0.683 | 0.734 | 0.800 | 0.822 | 0.864 | 0.906 | 0.937 | 0.962 | 1.045 |
| 40 | 0.277 | 0.525 | 0.544 | 0.544 | 0.569 | 0.571 | 0.571 | 0.659 | 0.689 | 0.691 | 0.694 | 0.694 | 0.708 | 0.745 | 0.750 | 0.767 |
| 41 | 0.484 | 0.499 | 0.501 | 0.531 | 0.543 | 0.548 | 0.553 | 0.575 | 0.580 | 0.582 | 0.592 | 0.631 | 0.636 | 0.636 | 0.663 | 0.695 |
| 42 | 0.422 | 0.472 | 0.496 | 0.501 | 0.610 | 0.639 | 0.654 | 0.659 | 0.659 | 0.659 | 0.689 | 0.708 | 0.758 | 0.763 | 0.772 | 0.876 |
| 43 | 0.553 | 0.731 | 0.760 | 0.780 | 0.888 | 0.928 | 0.977 | 1.007 | 1.056 | 1.096 | 1.125 | 1.125 | 1.194 | 1.283 | 1.312 | 1.431 |
| 44 | 0.391 | 0.440 | 0.506 | 0.516 | 0.540 | 0.540 | 0.543 | 0.550 | 0.570 | 0.572 | 0.577 | 0.594 | 0.599 | 0.604 | 0.624 | 0.660 |
| 45 | 0.405 | 0.429 | 0.481 | 0.488 | 0.522 | 0.535 | 0.576 | 0.591 | 0.591 | 0.618 | 0.635 | 0.635 | 0.687 | 0.706 | 0.721 | 0.789 |
| 46 | 0.406 | 0.452 | 0.469 | 0.492 | 0.543 | 0.543 | 0.585 | 0.651 | 0.670 | 0.680 | 0.722 | 0.724 | 0.807 | 0.810 | 0.820 | 0.825 |
| 47 | 0.467 | 0.472 | 0.536 | 0.543 | 0.553 | 0.580 | 0.604 | 0.617 | 0.622 | 0.634 | 0.675 | 0.715 | 0.739 | 0.739 | 0.795 | 0.820 |
| 48 | 0.398 | 0.425 | 0.477 | 0.489 | 0.518 | 0.531 | 0.594 | 0.653 | 0.712 | 0.722 | 0.802 | 0.832 | 0.893 | 0.905 | 0.917 | 0.974 |
| 49 | 0.370 | 0.456 | 0.472 | 0.509 | 0.512 | 0.548 | 0.551 | 0.590 | 0.646 | 0.659 | 0.759 | 0.776 | 0.781 | 0.784 | 0.864 | 0.896 |
| 50 | 0.427 | 0.449 | 0.516 | 0.537 | 0.581 | 0.589 | 0.591 | 0.594 | 0.633 | 0.653 | 0.704 | 0.719 | 0.765 | 0.797 | 0.799 | 0.831 |

TABLE A-1. PRESENTED AREA (SQ. IN.)
(ICOSAHEDRON GAGE) (Continued)

PRESENTED AREA

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.402 | 0.427 | 0.560 | 0.609 | 0.737 | 0.757 | 0.787 | 0.821 | 0.856 | 0.885 | 0.890 | 0.895 | 0.920 | 0.925 | 0.980 | 1.053 |
| 0.408 | 0.452 | 0.492 | 0.526 | 0.570 | 0.625 | 0.625 | 0.625 | 0.832 | 0.866 | 0.876 | 0.876 | 1.039 | 1.070 | 1.172 | 1.282 |
| 0.543 | 0.548 | 0.567 | 0.715 | 0.725 | 0.725 | 0.730 | 0.760 | 0.779 | 0.784 | 0.804 | 0.814 | 0.839 | 0.839 | 0.800 | 0.890 |
| 0.338 | 0.501 | 0.535 | 0.619 | 0.634 | 0.663 | 0.747 | 0.821 | 0.994 | 1.033 | 1.231 | 1.240 | 1.364 | 1.443 | 1.526 | 1.670 |
| 0.456 | 0.476 | 0.633 | 0.673 | 0.690 | 0.742 | 0.786 | 0.821 | 0.831 | 0.944 | 0.989 | 1.010 | 1.053 | 1.067 | 1.132 | 1.204 |
| 0.338 | 0.644 | 0.684 | 0.713 | 0.773 | 0.802 | 0.852 | 0.921 | 0.950 | 1.060 | 1.069 | 1.079 | 1.140 | 1.246 | 1.256 | 1.385 |
| 0.458 | 0.498 | 0.562 | 0.686 | 0.646 | 0.670 | 0.749 | 0.754 | 0.779 | 0.784 | 0.810 | 0.820 | 0.828 | 0.863 | 0.951 | 0.961 |
| 0.289 | 0.619 | 0.619 | 0.713 | 0.723 | 0.738 | 0.777 | 0.910 | 0.910 | 0.915 | 1.004 | 1.004 | 1.078 | 1.192 | 1.281 | 1.344 |
| 0.452 | 0.516 | 0.556 | 0.560 | 0.625 | 0.728 | 0.827 | 0.856 | 0.866 | 0.876 | 1.212 | 1.266 | 1.281 | 1.385 | 1.310 | 1.592 |
| 0.486 | 0.586 | 0.590 | 0.614 | 0.674 | 0.680 | 0.693 | 0.723 | 0.740 | 0.767 | 0.772 | 0.802 | 0.822 | 0.915 | 0.926 | 0.985 |
| 0.525 | 0.525 | 0.604 | 0.732 | 0.742 | 0.821 | 0.940 | 0.949 | 1.040 | 1.040 | 1.385 | 1.385 | 1.394 | 1.453 | 1.453 | 1.600 |
| 0.639 | 0.668 | 0.732 | 0.841 | 0.856 | 0.861 | 0.870 | 0.885 | 0.905 | 0.905 | 0.935 | 0.985 | 0.915 | 0.935 | 0.935 | 0.994 |
| 0.398 | 0.447 | 0.713 | 0.718 | 0.733 | 0.802 | 0.837 | 0.856 | 0.945 | 0.963 | 1.024 | 1.060 | 1.246 | 1.325 | 1.335 | 1.394 |
| 0.517 | 0.630 | 0.655 | 0.660 | 0.773 | 0.783 | 0.802 | 0.900 | 1.197 | 1.237 | 1.434 | 1.533 | 1.617 | 1.730 | 1.804 | 1.942 |
| 0.435 | 0.480 | 0.618 | 0.628 | 0.677 | 0.697 | 0.727 | 0.765 | 0.765 | 0.860 | 0.904 | 0.958 | 0.980 | 1.006 | 1.027 | 1.131 |
| 0.531 | 0.550 | 0.555 | 0.595 | 0.624 | 0.733 | 0.762 | 0.772 | 0.782 | 0.792 | 1.063 | 1.090 | 1.090 | 1.113 | 1.117 | 1.350 |
| 0.622 | 0.637 | 0.755 | 0.760 | 0.800 | 0.834 | 0.839 | 0.849 | 0.850 | 0.962 | 1.109 | 1.200 | 1.214 | 1.240 | 1.250 | 1.481 |
| 0.585 | 0.600 | 0.619 | 0.624 | 0.693 | 0.733 | 0.807 | 0.876 | 0.896 | 0.925 | 0.930 | 1.004 | 1.000 | 1.000 | 1.113 | 1.137 |
| 0.565 | 0.565 | 0.737 | 0.737 | 0.757 | 0.836 | 0.871 | 0.890 | 0.979 | 1.004 | 1.043 | 1.083 | 1.107 | 1.127 | 1.147 | 1.280 |
| 0.434 | 0.572 | 0.607 | 0.661 | 0.700 | 0.700 | 0.725 | 0.779 | 0.780 | 0.789 | 0.814 | 0.853 | 0.873 | 0.880 | 0.903 | 0.912 |
| 0.586 | 0.546 | 0.792 | 0.802 | 0.802 | 0.970 | 0.990 | 1.079 | 1.079 | 1.315 | 1.365 | 1.454 | 1.464 | 1.700 | 1.700 | 1.870 |
| 0.614 | 0.663 | 0.673 | 0.712 | 0.934 | 0.998 | 1.013 | 1.087 | 1.339 | 1.363 | 1.556 | 1.685 | 1.750 | 1.822 | 1.950 | 2.083 |
| 0.523 | 0.671 | 0.700 | 0.710 | 0.720 | 0.863 | 0.922 | 1.005 | 1.031 | 1.000 | 1.341 | 1.351 | 1.430 | 1.450 | 1.480 | 1.682 |
| 0.635 | 0.670 | 0.700 | 0.759 | 0.912 | 0.912 | 0.951 | 0.976 | 1.030 | 1.035 | 1.099 | 1.100 | 1.237 | 1.272 | 1.336 | 1.430 |
| 0.508 | 0.681 | 0.854 | 0.859 | 0.873 | 0.893 | 1.036 | 1.051 | 1.130 | 1.169 | 1.327 | 1.376 | 1.384 | 1.411 | 1.411 | 1.640 |
| 0.467 | 0.669 | 0.748 | 0.750 | 0.798 | 0.882 | 0.891 | 1.044 | 1.217 | 1.232 | 1.241 | 1.409 | 1.577 | 1.600 | 1.725 | 2.000 |
| 0.482 | 0.571 | 0.837 | 0.916 | 1.005 | 1.025 | 1.035 | 1.064 | 1.133 | 1.262 | 1.291 | 1.311 | 1.530 | 1.686 | 1.745 | 1.785 |
| 0.839 | 0.940 | 0.977 | 1.007 | 1.056 | 1.155 | 1.224 | 1.234 | 1.303 | 1.333 | 1.4:2 | 1.500 | 1.550 | 1.580 | 1.747 | 1.866 |
| 0.602 | 0.761 | 0.800 | 0.900 | 0.900 | 1.117 | 1.166 | 1.186 | 1.195 | 1.294 | 1.610 | 1.630 | 1.719 | 1.700 | 1.700 | 2.074 |
| 0.674 | 0.694 | 0.961 | 0.971 | 1.119 | 1.150 | 1.207 | 1.227 | 1.267 | 1.365 | 1.415 | 1.464 | 1.494 | 1.523 | 1.563 | 1.701 |
| 0.602 | 0.830 | 1.046 | 1.075 | 1.105 | 1.125 | 1.125 | 1.154 | 1.174 | 1.283 | 1.322 | 1.342 | 1.371 | 1.500 | 1.540 | 1.600 |
| 0.685 | 0.763 | 0.813 | 0.842 | 0.872 | 0.897 | 0.906 | 1.005 | 1.009 | 1.160 | 1.183 | 1.281 | 1.296 | 1.400 | 1.503 | 1.563 |
| 0.600 | 0.618 | 0.776 | 0.850 | 0.899 | 0.909 | 1.023 | 1.314 | 1.343 | 1.397 | 1.447 | 1.624 | 1.600 | 1.876 | 1.985 | 1.979 |
| 0.683 | 0.871 | 0.890 | 1.050 | 1.090 | 1.157 | 1.195 | 1.196 | 1.374 | 1.512 | 1.710 | 1.729 | 1.820 | 1.937 | 2.045 | 2.203 |

## TABLE A-2. FRAGMENT DATA

| FRAG NO. | SOURCE | WEIGHT GRAINS | LMAX IN. | WMAX IN. | TMAX IN. | LAVG IN. | WAVG IN. | TAVG IN. | LWP IN. | LTP IN. | TWP IN. | CD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 155.3 | 1.29 | 0.29 | 0.25 | 1.3 | 0.3 | 0.25 | 3.25 | 3.19 | 1.13 | 0.94 |
| 2 | 2 | 1030.4 | SPHERE | | DIAMETER = 1.00 IN. | | | | ALL PERIMETERS = 3.14 IN. | | | CD = .42 |
| 3 | 3 | 833.0 | 0.76 | 0.76 | 0.76 | 0.8 | 0.8 | 0.76 | 3.06 | 3.06 | 3.06 | 0.64 |
| 4 | 5 | 110.7 | 0.93 | 0.60 | 0.49 | 0.9 | 0.5 | 0.13 | 2.38 | 2.19 | 1.75 | 0.91 |
| 5 | 5 | 112.3 | 1.73 | 0.40 | 0.21 | 1.6 | 0.4 | 0.09 | 3.63 | 3.50 | 1.25 | 1.19 |
| 6 | 5 | 113.2 | 1.02 | 0.60 | 0.25 | 1.0 | 0.5 | 0.12 | 2.56 | 2.13 | 1.50 | 1.06 |
| 7 | 5 | 115.2 | 1.01 | 0.60 | 0.27 | 1.0 | 0.5 | 0.12 | 2.69 | 2.25 | 1.50 | 1.05 |
| 8 | 5 | 119.7 | 1.29 | 0.81 | 0.21 | 1.2 | 0.6 | 0.08 | 3.25 | 2.75 | 1.75 | 1.34 |
| 9 | 5 | 121.5 | 1.24 | 0.58 | 0.23 | 1.1 | 0.5 | 0.11 | 3.06 | 2.69 | 1.50 | 0.93 |
| 10 | 5 | 121.8 | 1.40 | 0.72 | 0.22 | 1.2 | 0.7 | 0.07 | 3.44 | 2.38 | 1.50 | 0.97 |
| 11 | 5 | 128.6 | 1.04 | 0.71 | 0.27 | 1.1 | 0.5 | 0.12 | 2.81 | 2.31 | 1.50 | 0.76 |
| 12 | 5 | 128.8 | 0.94 | 0.79 | 0.28 | 0.8 | 0.8 | 0.10 | 2.75 | 2.00 | 1.75 | 0.88 |
| 13 | 5 | 130.0 | 0.83 | 0.80 | 0.44 | 0.7 | 0.6 | 0.16 | 2.31 | 2.00 | 1.94 | 0.83 |
| 14 | 5 | 132.9 | 1.00 | 0.75 | 0.33 | 1.0 | 0.5 | 0.14 | 2.88 | 2.31 | 1.94 | 0.96 |
| 15 | 5 | 135.5 | 1.02 | 0.76 | 0.32 | 0.9 | 0.6 | 0.13 | 2.75 | 2.38 | 1.69 | 0.98 |
| 16 | 5 | 150.1 | 1.76 | 0.55 | 0.28 | 1.7 | 0.4 | 0.11 | 3.69 | 3.50 | 1.50 | 0.95 |
| 17 | 5 | 155.5 | 1.28 | 0.63 | 0.32 | 1.3 | 0.5 | 0.12 | 3.00 | 2.63 | 1.50 | 0.94 |
| 18 | 5 | 158.6 | 1.36 | 0.71 | 0.34 | 1.4 | 0.4 | 0.14 | 3.06 | 2.75 | 1.81 | 0.83 |
| 19 | 5 | 161.1 | 0.98 | 0.74 | 0.26 | 1.0 | 0.6 | 0.14 | 2.81 | 2.13 | 1.69 | 1.21 |
| 20 | 5 | 170.2 | 1.43 | 0.82 | 0.37 | 1.3 | 0.6 | 0.12 | 3.38 | 2.81 | 1.81 | 1.29 |
| 21 | 5 | 180.5 | 1.70 | 0.74 | 0.27 | 1.5 | 0.6 | 0.11 | 3.75 | 3.38 | 1.63 | 1.38 |
| 22 | 5 | 200.7 | 1.84 | 0.65 | 0.30 | 1.5 | 0.6 | 0.12 | 4.00 | 4.00 | 1.44 | 1.10 |
| 23 | 5 | 213.8 | 1.33 | 0.73 | 0.38 | 1.1 | 0.6 | 0.17 | 3.13 | 2.75 | 1.88 | 1.02 |
| 24 | 5 | 214.6 | 1.07 | 0.90 | 0.26 | 1.0 | 0.8 | 0.14 | 3.19 | 2.38 | 1.94 | 1.40 |
| 25 | 5 | 230.4 | 1.51 | 0.81 | 0.29 | 1.5 | 0.6 | 0.13 | 3.56 | 2.88 | 1.94 | 1.38 |
| 26 | 5 | 238.4 | 1.48 | 0.73 | 0.41 | 1.5 | 0.6 | 0.14 | 3.69 | 3.06 | 1.75 | 1.19 |
| 27 | 5 | 241.6 | 1.54 | 0.83 | 0.43 | 1.4 | 0.6 | 0.15 | 3.81 | 3.44 | 1.63 | 0.89 |
| 28 | 5 | 244.8 | 1.38 | 0.78 | 0.40 | 1.3 | 0.6 | 0.16 | 3.50 | 3.31 | 2.06 | 1.33 |
| 29 | 6 | 248.7 | 1.38 | 0.74 | 0.30 | 1.3 | 0.6 | 0.16 | 3.19 | 3.06 | 1.63 | 0.96 |
| 30 | 5 | 255.1 | 1.74 | 0.77 | 0.35 | 1.7 | 0.5 | 0.15 | 3.94 | 3.63 | 1.75 | 1.24 |
| 31 | 5 | 268.9 | 1.05 | 0.88 | 0.47 | 1.1 | 0.6 | 0.21 | 2.69 | 2.44 | 2.06 | 0.96 |
| 32 | 5 | 277.4 | 1.07 | 0.77 | 0.46 | 1.9 | 0.5 | 0.15 | 4.06 | 3.94 | 1.94 | 0.90 |
| 33 | 5 | 280.2 | 1.20 | 1.09 | 0.46 | 1.1 | 0.6 | 0.22 | 2.88 | 2.44 | 2.13 | 0.86 |
| 34 | 6 | 291.1 | 1.49 | 0.89 | 0.44 | 1.4 | 0.7 | 0.15 | 3.94 | 3.31 | 2.06 | 1.29 |
| 35 | 4 | 302.0 | 1.91 | 0.60 | 0.32 | 1.9 | 0.6 | 0.14 | 4.38 | 4.00 | 1.81 | 0.79 |
| 36 | 4 | 304.0 | 1.09 | 0.80 | 0.35 | 1.5 | 0.7 | 0.13 | 3.75 | 3.44 | 1.75 | 1.16 |
| 37 | 6 | 308.4 | 1.58 | 0.82 | 0.37 | 1.4 | 0.7 | 0.16 | 3.75 | 3.31 | 1.88 | 0.96 |
| 38 | 4 | 313.1 | 1.54 | 0.86 | 0.38 | 1.3 | 0.7 | 0.18 | 3.44 | 3.19 | 1.81 | 0.98 |
| 39 | 4 | 323.9 | 1.42 | 1.13 | 0.36 | 1.3 | 0.9 | 0.14 | 4.56 | 2.81 | 2.63 | 0.86 |
| 40 | 5 | 325.7 | 1.56 | 0.78 | 0.57 | 1.4 | 0.6 | 0.20 | 3.44 | 3.44 | 1.81 | 0.82 |
| 41 | 4 | 333.2 | 1.12 | 1.09 | 0.80 | 1.1 | 0.8 | 0.19 | 2.88 | 2.75 | 2.69 | 0.76 |
| 42 | 6 | 335.0 | 1.73 | 0.66 | 0.33 | 1.5 | 0.6 | 0.19 | 4.25 | 3.94 | 1.75 | 0.98 |
| 43 | 4 | 352.0 | 2.71 | 0.84 | 0.19 | 2.6 | 0.7 | 0.10 | 7.25 | 5.25 | 1.94 | 0.95 |
| 44 | 4 | 354.0 | 1.17 | 0.63 | 0.74 | 1.1 | 0.7 | 0.23 | 3.31 | 3.06 | 2.25 | 0.72 |
| 45 | 4 | 354.9 | 1.34 | 0.95 | 0.58 | 1.2 | 0.7 | 0.22 | 3.38 | 3.06 | 2.25 | 0.88 |
| 46 | 3 | 357.9 | 1.35 | 1.14 | 0.51 | 1.3 | 0.7 | 0.20 | 3.81 | 3.06 | 2.25 | 0.83 |
| 47 | 6 | 359.2 | 1.43 | 0.82 | 0.67 | 1.4 | 0.7 | 0.19 | 3.88 | 3.13 | 2.31 | 0.87 |
| 48 | 5 | 360.2 | 1.38 | 1.23 | 0.46 | 1.2 | 0.9 | 0.17 | 4.00 | 2.88 | 2.81 | 1.04 |
| 49 | 5 | 370.3 | 1.38 | 0.85 | 0.43 | 1.3 | 0.8 | 0.18 | 3.88 | 2.88 | 2.06 | 1.14 |
| 50 | 4 | 381.8 | 1.12 | 0.99 | 0.62 | 1.2 | 0.8 | 0.20 | 3.69 | 2.94 | 2.56 | 1.11 |

## TABLE A-2. FRAGMENT DATA (Continued)

| FRAG NO. | SOURCE | WEIGHT GRAINS | LMAX IN. | WMAX IN. | TMAX IN. | LAVG IN. | WAVG IN. | TAVG IN. | LWP IN. | LTP IN. | TWP IN. | CD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 51 | 4 | 358.2 | 2.26 | 0.64 | 0.51 | 2.0 | 0.6 | 0.17 | 4.00 | 4.73 | 1.69 | 1.05 |
| 52 | 6 | 393.3 | 1.66 | 1.07 | 0.40 | 1.6 | 0.8 | 0.16 | 4.44 | 3.31 | 2.31 | 1.16 |
| 53 | 4 | 398 1 | 1.62 | 0.75 | 0.52 | 1.5 | 0.7 | 0.19 | 4.56 | 4.06 | 2.13 | 0.76 |
| 54 | 4 | 404.6 | 2.09 | 1.16 | 0.27 | 2.0 | 0.9 | 0.11 | 5.23 | 4.31 | 2.50 | 1.11 |
| 55 | 5 | 432.7 | 2.03 | 0.75 | 0.42 | 1.9 | 0.7 | 0.17 | 4.40 | 4.30 | 1.69 | 0.80 |
| 56 | 4 | 455.9 | 2.73 | 0.76 | 0.37 | 2.5 | 0.6 | 0.16 | 5.00 | 5.69 | 1.81 | 1.03 |
| 57 | 6 | 461.7 | 1.55 | 0.96 | 0.47 | 1.3 | 0.8 | 0.23 | 3.63 | 3.30 | 2.13 | 0.78 |
| 58 | 6 | 464.0 | 2.03 | 0.58 | 0.52 | 2.1 | 0.7 | 0.16 | 4.81 | 4.25 | 2.23 | 1.12 |
| 59 | 4 | 483.2 | 1.50 | 1.36 | 0.33 | 1.6 | 1.0 | 0.15 | 4.81 | 3.13 | 2.54 | 1.03 |
| 60 | 6 | 484.1 | 1.54 | 0.53 | 0.61 | 1.3 | 0.8 | 0.24 | 3.63 | 3.44 | 2.30 | 0.90 |
| 61 | 4 | 485.7 | 2.47 | 1.05 | 0.37 | 2.1 | 0.9 | 0.13 | 5.60 | 5.06 | 2.31 | 0.96 |
| 62 | 4 | 489.3 | 1.83 | 0.90 | 0.59 | 1.8 | 0.7 | 0.20 | 3.56 | 4.44 | 2.01 | 0.73 |
| 63 | 6 | 490.9 | 2.13 | 1.02 | 0.39 | 2.1 | 0.8 | 0.15 | 5.13 | 4.69 | 2.00 | 0.86 |
| 64 | 4 | 495.1 | 1.56 | 1.59 | 0.50 | 2.0 | 1.0 | 0.13 | 6.30 | 3.81 | 3.25 | 0.80 |
| 65 | 5 | 505.0 | 1.72 | 0.91 | 0.41 | 1.0 | 0.6 | 0.24 | 4.44 | 3.73 | 1.94 | 0.86 |
| 66 | 6 | 519.6 | 1.62 | 1.20 | 0.39 | 1.4 | 1.0 | 0.19 | 4.50 | 3.06 | 2.01 | 1.06 |
| 67 | 6 | 531.9 | 2.12 | 1.06 | 0.40 | 2.0 | 0.8 | 0.17 | 5.56 | 4.31 | 2.30 | 0.92 |
| 68 | 5 | 547.9 | 1.60 | 1.00 | 0.42 | 1.6 | 0.8 | 0.22 | 3.63 | 3.50 | 3.44 | 0.92 |
| 69 | 6 | 556.2 | 1.97 | 1.07 | 0.42 | 1.9 | 0.8 | 0.19 | 5.06 | 4.44 | 2.25 | 0.87 |
| 70 | 4 | 561.2 | 1.73 | 0.68 | 0.67 | 1.5 | 0.7 | 0.27 | 4.19 | 4.13 | 2.06 | 0.71 |
| 71 | 4 | 600.4 | 2.57 | 0.96 | 0.35 | 2.3 | 0.9 | 0.15 | 6.06 | 5.25 | 2.13 | 0.90 |
| 72 | 6 | 631.7 | 2.19 | 1.30 | 0.38 | 2.1 | 1.1 | 0.14 | 5.63 | 4.31 | 2.75 | 0.93 |
| 73 | 6 | 635.4 | 1.59 | 1.37 | 0.44 | 1.6 | 1.1 | 0.19 | 4.94 | 3.63 | 2.94 | 0.84 |
| 74 | 4 | 636.0 | 1.83 | 1.16 | 0.66 | 1.9 | 0.8 | 0.22 | 4.63 | 4.00 | 3.00 | 0.86 |
| 75 | 6 | 668.5 | 2.31 | 1.07 | 0.44 | 2.1 | 0.8 | 0.20 | 5.56 | 5.06 | 2.69 | 0.99 |
| 76 | 5 | 713.9 | 2.12 | 1.24 | 0.50 | 1.8 | 1.0 | 0.20 | 5.06 | 4.31 | 3.00 | 0.84 |
| 77 | 6 | 719.1 | 2.61 | 0.53 | 0.38 | 2.6 | 0.8 | 0.18 | 6.00 | 5.06 | 2.19 | 1.29 |
| 78 | 4 | 767.0 | 2.85 | 1.16 | 0.53 | 2.8 | 0.7 | 0.20 | 7.44 | 6.13 | 2.00 | 0.90 |
| 79 | 6 | 776.7 | 2.53 | 1.27 | 0.45 | 2.3 | 1.0 | 0.17 | 7.13 | 5.06 | 2.69 | 1.31 |
| 80 | 4 | 777.0 | 2.85 | 0.86 | 0.59 | 2.8 | 0.7 | 0.20 | 6.63 | 6.06 | 2.19 | 0.56 |
| 81 | 6 | 782.2 | 2.43 | 0.97 | 0.43 | [illegible] | 0.8 | 0.21 | 5.63 | 5.63 | 2.13 | 0.99 |
| 82 | 4 | 804.0 | 1.60 | 1.49 | 0.50 | 1.6 | 1.1 | 0.23 | 4.00 | 3.56 | 3.44 | 0.81 |
| 83 | 6 | 833.7 | 1.76 | 1.59 | 0.40 | 1.6 | 1.4 | 0.19 | 5.69 | 3.69 | 3.50 | 0.89 |
| 84 | 6 | 866.3 | 2.99 | 1.07 | 0.43 | 3.0 | 0.9 | 0.16 | 7.00 | 5.81 | 2.31 | 1.00 |
| 85 | 4 | 1617.7 | 3.23 | 1.27 | 0.56 | 2.7 | 1.1 | 0.28 | 7.81 | 6.75 | 2.81 | 0.93 |
| 86 | 6 | 1630.0 | 3.37 | 1.95 | 0.45 | 3.3 | 1.2 | 0.21 | 8.81 | 6.75 | 4.19 | 1.24 |
| 87 | 4 | 1799.4 | 3.53 | 2.05 | 0.66 | 3.3 | 1.2 | 0.23 | 8.00 | 6.56 | 3.69 | 0.90 |
| 88 | 6 | 1973.2 | 3.92 | 1.86 | 0.49 | 3.8 | 1.2 | 0.22 | 9.31 | 8.00 | 3.81 | 0.95 |
| 89 | 4 | 2005.7 | 2.59 | 1.49 | 0.97 | 2.5 | 0.9 | 0.45 | 5.75 | 5.69 | 3.00 | 0.80 |
| 90 | 6 | 2006.2 | 2.71 | 2.00 | 0.73 | 2.4 | 1.0 | 0.43 | 6.19 | 5.81 | 3.56 | 0.79 |
| 91 | 6 | 2035.6 | 3.30 | 1.84 | 0.46 | 3.0 | 1.4 | 0.25 | 8.00 | 6.25 | 3.88 | 0.99 |
| 92 | 4 | 2763.3 | 4.50 | 2.69 | 0.57 | 4.3 | 1.5 | 0.22 | 12.25 | 8.88 | 5.56 | 1.42 |
| 93 | 6 | 3140.0 | 4.39 | 1.98 | 0.46 | 4.1 | 1.5 | 0.26 | 13.06 | 10.00 | 3.31 | 1.01 |
| 94 | 4 | 3270.2 | 3.17 | 1.89 | 0.74 | 2.9 | 1.4 | 0.41 | 8.56 | 6.81 | 4.69 | 1.02 |
| 95 | 7 | 15595.1 | 3.17 | 2.81 | 2.33 | 3.1 | 2.0 | 1.28 | 9.63 | 8.88 | 8.19 | 0.50 |
| 96 | 7 | 23413.5 | 4.50 | 3.77 | 1.79 | 4.2 | 3.4 | 0.84 | 13.63 | 9.81 | 8.63 | 0.99 |

SOURCE CODE

1 - BAR (1/4 X 1/4 X 1 1/4)
2 - 1.00 IN. DIAMETER SPHERE
3 - .76 IN. PER SIDE CUBE
4 - 155MM M107 PROJECTILE
5 - 76MM MK 165 PROJECTILE
6 - MK 84 LOW DRAG BOMB
7 - MK 82 LOW DRAG BOMB

## TABLE A-3. ICOSAHEDRON VS CALCULATED AREAS

| FRAG | MIN AREA | | MAX AREA | | AVG AREA | | STD DEV | | VARIANCE | |
|---|---|---|---|---|---|---|---|---|---|---|
| NO. | ICOS | CALC | ICOS | CALC | ICOS | CALC | ICOS | CALC | ICOS | CALC |
| 1 | 0.20 | 0.07 | 0.43 | 0.50 | 0.34 | 0.38 | 0.07 | 0.09 | 0.005 | 0.008 |
| 2 | 0.79 | 0.79 | 0.79 | 0.79 | 0.78 | 0.79 | 0.00 | 0.00 | 0.000 | 0.000 |
| 3 | 0.64 | 0.58 | 0.98 | 1.00 | 0.87 | 0.87 | 0.10 | 0.09 | 0.009 | 0.000 |
| 4 | 0.19 | 0.06 | 0.37 | 0.47 | 0.30 | 0.31 | 0.05 | 0.11 | 0.003 | 0.012 |
| 5 | 0.17 | 0.04 | 0.58 | 0.66 | 0.37 | 0.41 | 0.11 | 0.16 | 0.013 | 0.027 |
| 6 | 0.16 | 0.06 | 0.41 | 0.52 | 0.30 | 0.34 | 0.07 | 0.12 | 0.005 | 0.015 |
| 7 | 0.20 | 0.06 | 0.41 | 0.52 | 0.30 | 0.34 | 0.07 | 0.12 | 0.005 | 0.015 |
| 8 | 0.18 | 0.05 | 0.58 | 0.73 | 0.37 | 0.44 | 0.12 | 0.19 | 0.015 | 0.036 |
| 9 | 0.18 | 0.06 | 0.50 | 0.57 | 0.35 | 0.37 | 0.09 | 0.14 | 0.009 | 0.019 |
| 10 | 0.23 | 0.05 | 0.70 | 0.85 | 0.43 | 0.49 | 0.15 | 0.22 | 0.023 | 0.050 |
| 11 | 0.20 | 0.06 | 0.49 | 0.57 | 0.34 | 0.37 | 0.08 | 0.14 | 0.007 | 0.018 |
| 12 | 0.21 | 0.08 | 0.51 | 0.65 | 0.33 | 0.40 | 0.10 | 0.16 | 0.010 | 0.027 |
| 13 | 0.21 | 0.10 | 0.36 | 0.44 | 0.28 | 0.31 | 0.05 | 0.10 | 0.002 | 0.009 |
| 14 | 0.19 | 0.07 | 0.46 | 0.52 | 0.34 | 0.35 | 0.07 | 0.12 | 0.006 | 0.014 |
| 15 | 0.22 | 0.08 | 0.46 | 0.56 | 0.34 | 0.37 | 0.07 | 0.13 | 0.005 | 0.017 |
| 16 | 0.21 | 0.05 | 0.57 | 0.71 | 0.42 | 0.46 | 0.11 | 0.17 | 0.011 | 0.029 |
| 17 | 0.21 | 0.06 | 0.55 | 0.67 | 0.38 | 0.43 | 0.10 | 0.16 | 0.009 | 0.026 |
| 18 | 0.25 | 0.06 | 0.52 | 0.60 | 0.38 | 0.41 | 0.08 | 0.13 | 0.007 | 0.018 |
| 19 | 0.21 | 0.08 | 0.52 | 0.62 | 0.36 | 0.41 | 0.10 | 0.15 | 0.010 | 0.021 |
| 20 | 0.22 | 0.07 | 0.62 | 0.80 | 0.44 | 0.50 | 0.10 | 0.20 | 0.010 | 0.039 |
| 21 | 0.20 | 0.06 | 0.74 | 0.92 | 0.48 | 0.56 | 0.16 | 0.23 | 0.026 | 0.054 |
| 22 | 0.28 | 0.07 | 0.80 | 0.92 | 0.55 | 0.57 | 0.16 | 0.23 | 0.025 | 0.053 |
| 23 | 0.27 | 0.10 | 0.61 | 0.69 | 0.45 | 0.47 | 0.10 | 0.16 | 0.010 | 0.024 |
| 24 | 0.27 | 0.11 | 0.75 | 0.82 | 0.46 | 0.52 | 0.16 | 0.20 | 0.025 | 0.040 |
| 25 | 0.26 | 0.06 | 0.79 | 0.93 | 0.53 | 0.59 | 0.17 | 0.23 | 0.029 | 0.051 |
| 26 | 0.29 | 0.08 | 0.76 | 0.93 | 0.54 | 0.59 | 0.14 | 0.23 | 0.020 | 0.051 |
| 27 | 0.34 | 0.09 | 0.75 | 0.87 | 0.54 | 0.57 | 0.12 | 0.21 | 0.015 | 0.043 |
| 28 | 0.33 | 0.10 | 0.75 | 0.81 | 0.54 | 0.54 | 0.12 | 0.19 | 0.014 | 0.036 |
| 29 | 0.35 | 0.10 | 0.69 | 0.81 | 0.52 | 0.54 | 0.11 | 0.19 | 0.011 | 0.035 |
| 30 | 0.30 | 0.08 | 0.74 | 0.89 | 0.51 | 0.59 | 0.12 | 0.21 | 0.016 | 0.043 |
| 31 | 0.34 | 0.12 | 0.57 | 0.71 | 0.46 | 0.51 | 0.07 | 0.15 | 0.005 | 0.022 |
| 32 | 0.29 | 0.07 | 0.81 | 0.99 | 0.62 | 0.65 | 0.14 | 0.23 | 0.019 | 0.055 |
| 33 | 0.36 | 0.13 | 0.60 | 0.71 | 0.48 | 0.51 | 0.07 | 0.15 | 0.005 | 0.022 |
| 34 | 0.31 | 0.11 | 0.84 | 1.01 | 0.61 | 0.65 | 0.14 | 0.24 | 0.018 | 0.059 |
| 35 | 0.31 | 0.06 | 1.05 | 1.17 | 0.68 | 0.74 | 0.23 | 0.29 | 0.053 | 0.084 |
| 36 | 0.36 | 0.10 | 0.99 | 1.08 | 0.62 | 0.69 | 0.18 | 0.26 | 0.031 | 0.069 |
| 37 | 0.30 | 0.11 | 0.85 | 1.01 | 0.61 | 0.66 | 0.15 | 0.24 | 0.023 | 0.058 |
| 38 | 0.35 | 0.12 | 0.79 | 0.95 | 0.55 | 0.63 | 0.14 | 0.22 | 0.019 | 0.048 |
| 39 | 0.42 | 0.13 | 1.05 | 1.19 | 0.71 | 0.74 | 0.20 | 0.30 | 0.040 | 0.089 |
| 40 | 0.26 | 0.12 | 0.77 | 0.89 | 0.62 | 0.62 | 0.12 | 0.20 | 0.015 | 0.039 |
| 41 | 0.48 | 0.15 | 0.70 | 0.92 | 0.58 | 0.62 | 0.06 | 0.21 | 0.004 | 0.043 |
| 42 | 0.42 | 0.11 | 0.88 | 0.95 | 0.65 | 0.65 | 0.12 | 0.21 | 0.015 | 0.046 |
| 43 | 0.55 | 0.07 | 1.43 | 1.84 | 1.02 | 1.07 | 0.24 | 0.49 | 0.056 | 0.236 |
| 44 | 0.39 | 0.16 | 0.66 | 0.83 | 0.55 | 0.60 | 0.07 | 0.17 | 0.004 | 0.029 |
| 45 | 0.41 | 0.15 | 0.79 | 0.89 | 0.59 | 0.62 | 0.11 | 0.19 | 0.012 | 0.037 |
| 46 | 0.41 | 0.14 | 0.83 | 0.96 | 0.64 | 0.66 | 0.14 | 0.21 | 0.020 | 0.046 |
| 47 | 0.47 | 0.13 | 0.82 | 1.02 | 0.63 | 0.69 | 0.11 | 0.24 | 0.012 | 0.055 |
| 48 | 0.40 | 0.15 | 0.97 | 1.11 | 0.68 | 0.72 | 0.19 | 0.27 | 0.037 | 0.071 |
| 49 | 0.37 | 0.15 | 0.90 | 1.06 | 0.64 | 0.71 | 0.16 | 0.25 | 0.025 | 0.064 |
| 50 | 0.43 | 0.16 | 0.83 | 1.00 | 0.64 | 0.68 | 0.12 | 0.23 | 0.015 | 0.052 |

## TABLE A-3. ICOSAHEDRON VS CALCULATED AREAS (Continued)

| FRAG | MIN AREA | | MAX AREA | | AVG AREA | | STD DEV | | VARIANCE | |
|---|---|---|---|---|---|---|---|---|---|---|
| NO. | ICOS | CALC | ICOS | CALC | ICOS | CALC | ICOS | CALC | ICOS | CALC |
| 51 | 0.40 | 0.10 | 1.05 | 1.25 | 0.78 | 0.82 | 0.19 | 0.30 | 0.037 | 0.088 |
| 52 | 0.41 | 0.13 | 1.20 | 1.31 | 0.77 | 0.83 | 0.26 | 0.32 | 0.068 | 0.104 |
| 53 | 0.54 | 0.13 | 0.90 | 1.10 | 0.75 | 0.74 | 0.11 | 0.25 | 0.012 | 0.064 |
| 54 | 0.34 | 0.10 | 1.67 | 1.82 | 0.96 | 1.07 | 0.41 | 0.48 | 0.169 | 0.228 |
| 55 | 0.46 | 0.12 | 1.20 | 1.37 | 0.85 | 0.88 | 0.23 | 0.33 | 051 | 0.111 |
| 56 | 0.36 | 0.09 | 1.39 | 1.55 | 0.93 | 0.99 | 0.27 | 0.36 | 0.[illegible] | 0.144 |
| 57 | 0.46 | 0.18 | 0.96 | 1.10 | 0.73 | 0.76 | 0.15 | 0.24 | 0.022 | 0.059 |
| 58 | 0.29 | 0.11 | 1.34 | 1.51 | 0.87 | 0.96 | 0.26 | 0.37 | 0.069 | 0.136 |
| 59 | 0.45 | 0.15 | 1.55 | 1.63 | 0.92 | 1.00 | 0.35 | 0.41 | 0.121 | 0.169 |
| 60 | 0.49 | 0.19 | 0.97 | 1.10 | 0.73 | 0.77 | 0.14 | 0.24 | 0.020 | 0.057 |
| 61 | 0.53 | 0.12 | 1.66 | 1.91 | 1.03 | 1.14 | 0.36 | 0.50 | 0.131 | 0.246 |
| 62 | 0.64 | 0.14 | 0.99 | 1.32 | 0.86 | 0.88 | 0.10 | 0.31 | 0.010 | 0.094 |
| 63 | 0.40 | 0.12 | 1.39 | 1.71 | 0.93 | 1.06 | 0.30 | 0.43 | 0.089 | 0.187 |
| 64 | 0.52 | 0.13 | 1.94 | 2.02 | 1.15 | 1.19 | 0.47 | 0.53 | 0.225 | 0.280 |
| 65 | 0.46 | 0.14 | 1.13 | 1.17 | 0.79 | 0.83 | 0.20 | 0.25 | 0.040 | 0.063 |
| 66 | 0.53 | 0.19 | 1.36 | 1.44 | 0.85 | 0.93 | 0.26 | 0.35 | 0.067 | 0.120 |
| 67 | 0.62 | 0.14 | 1.45 | 1.64 | 0.97 | 1.04 | 0.25 | 0.40 | 0.064 | 0.164 |
| 68 | 0.59 | 0.17 | 1.14 | 1.34 | 0.86 | 0.90 | 0.20 | 0.31 | 0.039 | 0.094 |
| 69 | 0.57 | 0.15 | 1.28 | 1.57 | 0.92 | 1.01 | 0.21 | 0.38 | 0.044 | 0.143 |
| 70 | 0.43 | 0.19 | 0.91 | 1.14 | 0.75 | 0.82 | 0.13 | 0.24 | 0.018 | 0.055 |
| 71 | 0.51 | 0.13 | 1.88 | 2.10 | 1.15 | 1.27 | 0.42 | 0.54 | 0.174 | 0.290 |
| 72 | 0.61 | 0.16 | 2.09 | 2.34 | 1.26 | 1.39 | 0.49 | 0.61 | 0.242 | 0.370 |
| 73 | 0.52 | 0.21 | 1.69 | 1.80 | 1.06 | 1.14 | 0.36 | 0.44 | 0.127 | 0.196 |
| 74 | 0.64 | 0.18 | 1.44 | 1.59 | 1.01 | 1.06 | 0.24 | 0.37 | 0.059 | 0.136 |
| 75 | 0.51 | 0.16 | 1.65 | 1.74 | 1.10 | 1.13 | 0.31 | 0.42 | 0.097 | 0.173 |
| 76 | 0.47 | 0.20 | 2.00 | 1.85 | 1.14 | 1.18 | 0.44 | 0.45 | 0.196 | 0.202 |
| 77 | 0.48 | 0.14 | 1.76 | 2.13 | 1.17 | 1.34 | 0.38 | 0.53 | 0.147 | 0.281 |
| 78 | 0.84 | 0.14 | 1.86 | 2.04 | 1.29 | 1.33 | 0.30 | 0.49 | 0.088 | 0.238 |
| 79 | 0.68 | 0.17 | 2.07 | 2.34 | 1.30 | 1.43 | 0.42 | 0.59 | 0.175 | 0.352 |
| 80 | 0.67 | 0.14 | 1.70 | 2.05 | 1.24 | 1.33 | 0.30 | 0.49 | 0.090 | 0.238 |
| 81 | 0.60 | 0.17 | 1.61 | 1.99 | 1.20 | 1.29 | 0.26 | 0.48 | 0.067 | 0.227 |
| 82 | 0.69 | 0.26 | 1.55 | 1.82 | 1.08 | 1.19 | 0.28 | 0.43 | 0.078 | 0.184 |
| 83 | 0.61 | 0.27 | 1.98 | 2.28 | 1.27 | 1.40 | 0.46 | 0.57 | 0.216 | 0.329 |
| 84 | 0.68 | 0.15 | 2.20 | 2.75 | 1.41 | 1.67 | 0.46 | 0.70 | 0.210 | 0.494 |
| 85 | | 0.31 | | 3.08 | | 2.01 | | 0.73 | | 0.535 |
| 86 | | 0.26 | | 4.03 | | 2.46 | | 1.03 | | 1.053 |
| 87 | | 0.28 | | 4.04 | | 2.50 | | 1.02 | | 1.034 |
| 88 | | 0.26 | | 4.64 | | 2.83 | | 1.18 | | 1.400 |
| 89 | | 0.41 | | 2.55 | | 1.90 | | 0.50 | | 0.245 |
| 90 | | 0.43 | | 2.64 | | 1.93 | | 0.54 | | 0.286 |
| 91 | | 0.35 | | 4.28 | | 2.64 | | 1.08 | | 1.161 |
| 92 | | 0.33 | | 6.53 | | 3.86 | | 1.71 | | 2.908 |
| 93 | | 0.39 | | 6.25 | | 3.81 | | 1.60 | | 2.549 |
| 94 | | 0.58 | | 4.27 | | 2.92 | | 0.96 | | 0.925 |
| 95 | | 2.57 | | 7.80 | | 6.37 | | 1.11 | | 1.232 |
| 96 | | 2.84 | | 14.98 | | 10.32 | | 3.33 | | 11.078 |

EXPLANATION OF COLUMN HEADINGS
MIN AREA - MINIMUM PRESENTED AREA (SQ. IN.)
MAX AREA - MAXIMUM PRESENTED AREA (SQ. IN.)
AVG AREA - AVERAGE PRESENTED AREA (SQ. IN.)
STD DEV - STANDARD DEVIATION OF PRESENTED AREA (SQ. IN.)
VARIANCE - VARIANCE OF PRESENTED AREA (IN. 4TH)
ICOS - AREAS CALCULATED FROM ICOSAHEDRON GAGE DATA
CALC - AREAS CALCULATED FROM APPROXIMATING RECTANGULAR PARALLELEPIPEDS

## TABLE A-4. PRESENTED AREA RATIOS

| FRAG | NO. | | MAX / | MIN | MAX / | AVG | AVG / | MIN |
|---|---|---|---|---|---|---|---|---|
| NEW | OLD | CD | ICOS | CALC | ICOS | CALC | ICOS | CALC |
| 1 | 2 | 0.42 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 2 | 95 | 0.50 | | 3.04 | | 1.22 | | 2.40 |
| 3 | 3 | 0.64 | 1.54 | 1.73 | 1.13 | 1.15 | 1.36 | 1.50 |
| 4 | 70 | 0.71 | 2.10 | 5.99 | 1.22 | 1.39 | 1.73 | 4.32 |
| 5 | 44 | 0.72 | 1.69 | 5.05 | 1.20 | 1.39 | 1.41 | 3.63 |
| 6 | 62 | 0.73 | 1.56 | 9.49 | 1.16 | 1.50 | 1.34 | 6.33 |
| 7 | 53 | 0.76 | 1.65 | 8.16 | 1.20 | 1.49 | 1.38 | 5.48 |
| 8 | 41 | 0.76 | 1.44 | 5.94 | 1.20 | 1.47 | 1.19 | 4.03 |
| 9 | 11 | 0.76 | 2.42 | 9.53 | 1.45 | 1.53 | 1.67 | 6.21 |
| 10 | 57 | 0.78 | 2.10 | 6.05 | 1.31 | 1.45 | 1.60 | 4.18 |
| 11 | 35 | 0.79 | 3.36 | 14.41 | 1.55 | 1.58 | 2.17 | 9.09 |
| 12 | 90 | 0.79 | | 6.20 | | 1.37 | | 4.51 |
| 13 | 45 | 0.80 | 1.95 | 5.91 | 1.34 | 1.43 | 1.46 | 4.14 |
| 14 | 89 | 0.80 | | 6.24 | | 1.35 | | 4.64 |
| 15 | 82 | 0.81 | 2.27 | 7.08 | 1.43 | 1.52 | 1.58 | 4.66 |
| 16 | 40 | 0.82 | 2.77 | 7.52 | 1.23 | 1.44 | 2.26 | 5.21 |
| 17 | 13 | 0.83 | 1.72 | 4.67 | 1.26 | 1.43 | 1.37 | 3.29 |
| 18 | 46 | 0.83 | 2.03 | 6.81 | 1.29 | 1.46 | 1.57 | 4.67 |
| 19 | 18 | 0.83 | 2.11 | 10.35 | 1.37 | 1.46 | 1.54 | 7.09 |
| 20 | 73 | 0.84 | 3.24 | 8.60 | 1.59 | 1.58 | 2.03 | 5.44 |
| 21 | 76 | 0.84 | 4.28 | 9.13 | 1.75 | 1.56 | 2.44 | 5.85 |
| 22 | 63 | 0.86 | 3.50 | 14.36 | 1.51 | 1.62 | 2.33 | 8.86 |
| 23 | 33 | 0.86 | 1.66 | 5.49 | 1.24 | 1.39 | 1.33 | 3.96 |
| 24 | 74 | 0.86 | 2.27 | 9.01 | 1.43 | 1.50 | 1.59 | 6.00 |
| 25 | 39 | 0.86 | 2.50 | 9.37 | 1.47 | 1.61 | 1.70 | 5.82 |
| 26 | 65 | 0.86 | 2.49 | 8.18 | 1.42 | 1.42 | 1.75 | 5.77 |
| 27 | 47 | 0.87 | 1.76 | 7.81 | 1.30 | 1.49 | 1.35 | 5.24 |
| 28 | 69 | 0.87 | 2.27 | 10.50 | 1.39 | 1.55 | 1.63 | 6.78 |
| 29 | 55 | 0.88 | 2.63 | 11.81 | 1.42 | 1.56 | 1.86 | 7.58 |
| 30 | 64 | 0.88 | 3.76 | 15.99 | 1.69 | 1.70 | 2.22 | 9.42 |
| 31 | 12 | 0.88 | 2.38 | 7.92 | 1.52 | 1.62 | 1.56 | 4.90 |
| 32 | 27 | 0.89 | 2.20 | 9.87 | 1.37 | 1.53 | 1.60 | 6.44 |
| 33 | 83 | 0.89 | 3.25 | 8.56 | 1.56 | 1.62 | 2.08 | 5.28 |
| 34 | 78 | 0.90 | 2.21 | 14.62 | 1.43 | 1.54 | 1.54 | 9.51 |
| 35 | 32 | 0.90 | 2.81 | 13.35 | 1.31 | 1.52 | 2.15 | 8.78 |
| 36 | 60 | 0.90 | 1.99 | 5.80 | 1.32 | 1.43 | 1.50 | 4.05 |
| 37 | 4 | 0.91 | 1.90 | 7.46 | 1.23 | 1.50 | 1.54 | 4.99 |
| 38 | 67 | 0.92 | 2.33 | 12.10 | 1.50 | 1.58 | 1.56 | 7.65 |
| 39 | 68 | 0.92 | 1.94 | 7.66 | 1.33 | 1.48 | 1.47 | 5.16 |
| 40 | 85 | 0.93 | | 10.07 | | 1.53 | | 6.59 |
| 41 | 72 | 0.93 | 3.41 | 14.75 | 1.66 | 1.69 | 2.05 | 6.75 |
| 42 | 9 | 0.93 | 2.71 | 10.05 | 1.41 | 1.55 | 1.93 | 6.48 |
| 43 | 1 | 0.94 | 2.19 | 6.92 | 1.29 | 1.30 | 1.70 | 5.33 |
| 44 | 17 | 0.94 | 2.63 | 11.01 | 1.45 | 1.55 | 1.82 | 7.13 |
| 45 | 88 | 0.95 | | 17.53 | | 1.64 | | 10.69 |
| 46 | 43 | 0.95 | 2.59 | 26.57 | 1.41 | 1.71 | 1.84 | 15.50 |
| 47 | 16 | 0.95 | 2.75 | 15.71 | 1.35 | 1.54 | 2.04 | 10.17 |
| 48 | 80 | 0.96 | 2.52 | 14.44 | 1.37 | 1.53 | 1.84 | 9.42 |
| 49 | 31 | 0.96 | 1.66 | 5.69 | 1.23 | 1.40 | 1.35 | 4.06 |
| 50 | 29 | 0.96 | 1.97 | 8.34 | 1.33 | 1.49 | 1.48 | 5.58 |

## TABLE A-4. PRESENTED AREA RATIOS (Continued)

| FRAG NO. NEW | OLD | CD | MAX / MIN ICOS | MAX / MIN CALC | MAX / AVG ICOS | MAX / AVG CALC | AVG / MIN ICOS | AVG / MIN CALC |
|---|---|---|---|---|---|---|---|---|
| 51 | 37 | 0.96 | 2.84 | 8.97 | 1.41 | 1.54 | 2.02 | 5.85 |
| 52 | 61 | 0.96 | 3.16 | 16.18 | 1.61 | 1.68 | 1.96 | 9.66 |
| 53 | 14 | 0.96 | 2.41 | 7.71 | 1.34 | 1.49 | 1.79 | 5.19 |
| 54 | 10 | 0.97 | 3.04 | 16.34 | 1.61 | 1.73 | 1.89 | 9.47 |
| 55 | 87 | 0.98 | | 14.53 | | 1.62 | | 8.99 |
| 56 | 71 | 0.98 | 3.71 | 15.58 | 1.63 | 1.65 | 2.28 | 9.45 |
| 57 | 15 | 0.98 | 2.06 | 7.26 | 1.34 | 1.52 | 1.54 | 4.76 |
| 58 | 38 | 0.98 | 2.26 | 7.70 | 1.43 | 1.50 | 1.57 | 5.13 |
| 59 | 42 | 0.98 | 2.08 | 8.33 | 1.36 | 1.46 | 1.53 | 5.69 |
| 60 | 75 | 0.99 | 3.24 | 10.72 | 1.50 | 1.53 | 2.17 | 6.98 |
| 61 | 96 | 0.99 | | 5.27 | | 1.45 | | 3.63 |
| 62 | 91 | 0.99 | | 12.36 | | 1.62 | | 7.64 |
| 63 | 81 | 0.99 | 2.67 | 11.97 | 1.34 | 1.54 | 2.00 | 7.77 |
| 64 | 84 | 1.00 | 3.23 | 18.65 | 1.57 | 1.65 | 2.06 | 11.33 |
| 65 | 93 | 1.01 | | 15.97 | | 1.64 | | 9.72 |
| 66 | 94 | 1.02 | | 7.41 | | 1.46 | | 5.06 |
| 67 | 23 | 1.02 | 2.25 | 6.98 | 1.35 | 1.47 | 1.67 | 4.74 |
| 68 | 59 | 1.03 | 3.43 | 10.55 | 1.68 | 1.63 | 2.04 | 6.49 |
| 69 | 56 | 1.03 | 3.87 | 16.68 | 1.48 | 1.57 | 2.61 | 10.64 |
| 70 | 48 | 1.04 | 2.45 | 7.25 | 1.44 | 1.54 | 1.70 | 4.69 |
| 71 | 51 | 1.05 | 2.62 | 12.55 | 1.35 | 1.53 | 1.95 | 8.19 |
| 72 | 7 | 1.05 | 2.09 | 8.80 | 1.36 | 1.53 | 1.54 | 5.75 |
| 73 | 6 | 1.06 | 2.62 | 8.94 | 1.39 | 1.53 | 1.89 | 5.83 |
| 74 | 66 | 1.06 | 2.56 | 7.59 | 1.61 | 1.55 | 1.59 | 4.90 |
| 75 | 50 | 1.11 | 1.95 | 6.18 | 1.31 | 1.47 | 1.49 | 4.21 |
| 76 | 54 | 1.11 | 4.94 | 17.51 | 1.74 | 1.70 | 2.84 | 10.33 |
| 77 | 58 | 1.12 | 4.65 | 13.40 | 1.54 | 1.57 | 3.03 | 8.51 |
| 78 | 49 | 1.14 | 2.42 | 7.41 | 1.41 | 1.51 | 1.72 | 4.89 |
| 79 | 36 | 1.16 | 2.73 | 10.40 | 1.60 | 1.57 | 1.70 | 6.64 |
| 80 | 52 | 1.16 | 2.95 | 10.45 | 1.57 | 1.58 | 1.88 | 6.60 |
| 81 | 22 | 1.18 | 2.86 | 13.27 | 1.47 | 1.61 | 1.95 | 8.24 |
| 82 | 5 | 1.19 | 3.37 | 18.34 | 1.55 | 1.60 | 2.17 | 11.44 |
| 83 | 26 | 1.19 | 2.60 | 11.38 | 1.41 | 1.56 | 1.84 | 7.28 |
| 84 | 19 | 1.21 | 2.43 | 7.55 | 1.45 | 1.52 | 1.68 | 4.98 |
| 85 | 86 | 1.24 | | 15.79 | | 1.64 | | 9.63 |
| 86 | 30 | 1.24 | 2.49 | 11.65 | 1.43 | 1.50 | 1.74 | 7.75 |
| 87 | 77 | 1.29 | 3.64 | 15.13 | 1.51 | 1.59 | 2.42 | 9.50 |
| 88 | 34 | 1.29 | 2.69 | 9.50 | 1.38 | 1.55 | 1.94 | 6.12 |
| 89 | 20 | 1.29 | 2.77 | 11.41 | 1.41 | 1.59 | 1.97 | 7.16 |
| 90 | 35 | 1.30 | 3.05 | 11.51 | 1.50 | 1.57 | 2.04 | 7.35 |
| 91 | 79 | 1.31 | 3.04 | 13.58 | 1.60 | 1.63 | 1.90 | 8.32 |
| 92 | 28 | 1.33 | 2.26 | 8.46 | 1.40 | 1.50 | 1.61 | 5.64 |
| 93 | 8 | 1.34 | 3.17 | 14.32 | 1.55 | 1.67 | 2.05 | 8.57 |
| 94 | 21 | 1.38 | 3.72 | 14.29 | 1.56 | 1.63 | 2.38 | 8.77 |
| 95 | 92 | 1.42 | | 19.91 | | 1.69 | | 11.77 |
| 96 | 24 | 1.48 | 2.81 | 7.48 | 1.61 | 1.57 | 1.74 | 4.78 |

ICOS - PRESENTED AREA RATIOS CALCULATED FROM ICOSAHEDRON GAGE DATA
CALC - PRESENTED AREA RATIOS CALCULATED FROM APPROXIMATING RECTANGULAR PARALLELEPIPEDS

## TABLE A-5. LINEAR AND STATISTICAL RATIOS

| FRAG NO. NEW | OLD | CD | L/T | W/T | L'/T' | W'/T' | SD / AAVG ICOS | SD / AAVG CALC | VAR / AAVG↑2 ICOS | VAR / AAVG↑2 CALC |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 0.42 | (SPHERE) | | | | | | | |
| 2 | 95 | 0.50 | 2.42 | 1.56 | 1.74 | 1.33 | | 0.17 | | 0.03 |
| 3 | 3 | 0.64 | 1.00 | 1.00 | 1.00 | 1.00 | 0.11 | 0.10 | 0.01 | 0.01 |
| 4 | 70 | 0.71 | 5.50 | 2.57 | 3.43 | 1.46 | 0.18 | 0.29 | 0.03 | 0.10 |
| 5 | 44 | 0.72 | 4.69 | 2.98 | 2.33 | 1.56 | 0.12 | 0.29 | 0.01 | 0.14 |
| 6 | 62 | 0.73 | 9.08 | 3.53 | 4.61 | 2.03 | 0.11 | 0.35 | 0.01 | 0.14 |
| 7 | 53 | 0.76 | 7.81 | 3.65 | 4.38 | 2.04 | 0.15 | 0.34 | 0.02 | 0.16 |
| 8 | 41 | 0.76 | 5.69 | 4.14 | 2.24 | 1.90 | 0.11 | 0.33 | 0.01 | 0.18 |
| 9 | 11 | 0.76 | 9.22 | 4.19 | 5.50 | 3.11 | 0.25 | 0.37 | 0.06 | 0.36 |
| 10 | 57 | 0.78 | 5.74 | 3.53 | 4.11 | 2.53 | 0.20 | 0.32 | 0.04 | 0.13 |
| 11 | 35 | 0.79 | 14.02 | 4.43 | 8.36 | 2.81 | 0.34 | 0.39 | 0.12 | 0.21 |
| 12 | 90 | 0.79 | 5.63 | 2.34 | 4.42 | 2.66 | | 0.28 | | 0.08 |
| 13 | 45 | 0.80 | 5.57 | 3.25 | 3.55 | 2.31 | 0.18 | 0.31 | 0.03 | 0.15 |
| 14 | 89 | 0.80 | 5.50 | 1.98 | 3.57 | 1.68 | | 0.26 | | 0.07 |
| 15 | 82 | 0.81 | 6.86 | 4.71 | 4.03 | 3.18 | 0.26 | 0.36 | 0.07 | 0.11 |
| 16 | 40 | 0.82 | 7.08 | 3.03 | 3.86 | 1.80 | 0.20 | 0.32 | 0.04 | 0.16 |
| 17 | 13 | 0.83 | 4.41 | 3.78 | 2.55 | 2.34 | 0.16 | 0.30 | 0.03 | 0.30 |
| 18 | 46 | 0.83 | 6.48 | 3.49 | 3.73 | 2.59 | 0.22 | 0.33 | 0.05 | 0.16 |
| 19 | 18 | 0.83 | 9.69 | 2.77 | 5.70 | 2.29 | 0.21 | 0.33 | 0.05 | 0.26 |
| 20 | 73 | 0.84 | 8.42 | 5.79 | 5.06 | 3.92 | 0.34 | 0.39 | 0.11 | 0.13 |
| 21 | 76 | 0.84 | 8.90 | 4.94 | 5.58 | 3.19 | 0.39 | 0.38 | 0.15 | 0.12 |
| 22 | 63 | 0.86 | 14.09 | 5.37 | 7.85 | 3.38 | 0.32 | 0.41 | 0.10 | 0.16 |
| 23 | 33 | 0.86 | 5.08 | 2.77 | 3.40 | 2.50 | 0.15 | 0.29 | 0.02 | 0.16 |
| 24 | 74 | 0.86 | 8.63 | 3.63 | 4.24 | 2.23 | 0.24 | 0.35 | 0.06 | 0.11 |
| 25 | 39 | 0.86 | 9.20 | 6.37 | 5.43 | 4.05 | 0.28 | 0.40 | 0.08 | 0.22 |
| 26 | 65 | 0.86 | 7.55 | 2.52 | 5.43 | 2.33 | 0.25 | 0.30 | 0.06 | 0.11 |
| 27 | 47 | 0.87 | 7.49 | 3.74 | 3.49 | 1.86 | 0.17 | 0.34 | 0.03 | 0.17 |
| 28 | 69 | 0.87 | 10.18 | 4.29 | 6.38 | 3.08 | 0.23 | 0.37 | 0.05 | 0.14 |
| 29 | 55 | 0.88 | 11.45 | 4.22 | 6.71 | 2.47 | 0.27 | 0.38 | 0.07 | 0.16 |
| 30 | 64 | 0.88 | 15.84 | 7.92 | 6.32 | 4.14 | 0.41 | 0.45 | 0.17 | 0.17 |
| 31 | 12 | 0.88 | 7.79 | 7.79 | 4.55 | 4.15 | 0.30 | 0.41 | 0.09 | 0.41 |
| 32 | 27 | 0.89 | 9.54 | 4.09 | 5.10 | 2.48 | 0.23 | 0.37 | 0.05 | 0.24 |
| 33 | 83 | 0.89 | 8.43 | 7.37 | 5.70 | 5.07 | 0.37 | 0.41 | 0.13 | 0.12 |
| 34 | 78 | 0.90 | 14.02 | 3.51 | 7.74 | 2.55 | 0.23 | 0.37 | 0.05 | 0.10 |
| 35 | 32 | 0.90 | 12.75 | 3.36 | 6.19 | 2.09 | 0.22 | 0.36 | 0.05 | 0.20 |
| 36 | 60 | 0.90 | 5.47 | 3.37 | 3.35 | 2.04 | 0.19 | 0.31 | 0.04 | 0.13 |
| 37 | 4 | 0.91 | 7.17 | 3.98 | 2.97 | 1.79 | 0.17 | 0.35 | 0.03 | 0.38 |
| 38 | 67 | 0.92 | 11.79 | 4.72 | 7.23 | 3.27 | 0.26 | 0.39 | 0.07 | 0.15 |
| 39 | 68 | 0.92 | 7.33 | 3.66 | 5.01 | 2.82 | 0.23 | 0.34 | 0.05 | 0.13 |
| 40 | 85 | 0.93 | 9.72 | 3.96 | 7.08 | 2.83 | | 0.36 | | 0.13 |
| 41 | 72 | 0.93 | 14.59 | 7.64 | 9.66 | 5.41 | 0.39 | 0.44 | 0.15 | 0.14 |
| 42 | 9 | 0.93 | 9.76 | 4.44 | 5.81 | 2.68 | 0.27 | 0.37 | 0.07 | 0.38 |
| 43 | 1 | 0.94 | 5.17 | 1.15 | 5.16 | 1.15 | 0.21 | 0.23 | 0.04 | 0.14 |
| 44 | 17 | 0.94 | 10.65 | 4.10 | 5.84 | 2.56 | 0.26 | 0.37 | 0.07 | 0.32 |
| 45 | 88 | 0.95 | 17.21 | 5.44 | 10.86 | 4.31 | | 0.42 | | 0.17 |
| 46 | 43 | 0.95 | 26.29 | 7.08 | 18.38 | 5.33 | 0.23 | 0.45 | 0.05 | 0.19 |
| 47 | 16 | 0.95 | 15.10 | 3.55 | 8.76 | 2.42 | 0.25 | 0.37 | 0.06 | 0.30 |
| 48 | 80 | 0.96 | 13.84 | 3.46 | 8.05 | 2.22 | 0.24 | 0.37 | 0.06 | 0.10 |
| 49 | 31 | 0.96 | 5.29 | 2.89 | 3.17 | 2.18 | 0.15 | 0.29 | 0.02 | 0.17 |
| 50 | 29 | 0.96 | 7.99 | 3.69 | 4.94 | 2.47 | 0.20 | 0.35 | 0.04 | 0.22 |

TABLE A-5. LINEAR AND STATISTICAL RATIOS (Continued)

| FRAG NO. NEW | OLD | CD | L/T | W/T | L'/T' | W'/T' | SD / AAVG ICOS | SD / AAVG CALC | VAR / AAVG↑2 ICOS | VAR / AAVG↑2 CALC |
|---|---|---|---|---|---|---|---|---|---|---|
| 51 | 37 | 0.96 | 8.69 | 4.35 | 5.61 | 2.86 | 0.25 | 0.37 | 0.06 | 0.20 |
| 52 | 61 | 0.96 | 15.98 | 6.85 | 9.11 | 3.89 | 0.35 | 0.43 | 0.12 | 0.17 |
| 53 | 14 | 0.96 | 7.37 | 3.69 | 4.30 | 2.68 | 0.22 | 0.34 | 0.05 | 0.33 |
| 54 | 10 | 0.97 | 16.22 | 9.46 | 9.12 | 4.83 | 0.35 | 0.46 | 0.12 | 0.43 |
| 55 | 87 | 0.98 | 14.23 | 5.18 | 7.66 | 3.64 | | 0.41 | | 0.17 |
| 56 | 71 | 0.98 | 15.34 | 6.00 | 9.74 | 3.72 | 0.36 | 0.42 | 0.13 | 0.14 |
| 57 | 15 | 0.98 | 7.03 | 4.69 | 4.29 | 3.04 | 0.21 | 0.36 | 0.05 | 0.35 |
| 58 | 38 | 0.98 | 7.41 | 3.99 | 5.11 | 2.81 | 0.25 | 0.35 | 0.06 | 0.19 |
| 59 | 42 | 0.98 | 7.88 | 3.15 | 5.98 | 2.33 | 0.19 | 0.33 | 0.04 | 0.17 |
| 60 | 75 | 0.99 | 10.34 | 3.94 | 6.86 | 2.91 | 0.28 | 0.37 | 0.08 | 0.12 |
| 61 | 96 | 0.99 | 5.02 | 4.06 | 3.34 | 2.73 | | 0.32 | | 0.10 |
| 62 | 91 | 0.99 | 12.13 | 5.66 | 8.91 | 4.58 | | 0.41 | | 0.17 |
| 63 | 81 | 0.99 | 11.55 | 3.85 | 7.57 | 2.77 | 0.22 | 0.37 | 0.05 | 0.11 |
| 64 | 84 | 1.00 | 18.33 | 5.50 | 10.09 | 3.32 | 0.33 | 0.42 | 0.11 | 0.11 |
| 65 | 93 | 1.01 | 15.70 | 5.74 | 12.05 | 4.83 | | 0.42 | | 0.18 |
| 66 | 94 | 1.02 | 7.04 | 3.40 | 5.27 | 2.86 | | 0.33 | | 0.11 |
| 67 | 23 | 1.02 | 6.66 | 3.63 | 4.46 | 2.44 | 0.22 | 0.33 | 0.05 | 0.24 |
| 68 | 59 | 1.03 | 10.38 | 6.49 | 6.57 | 4.88 | 0.38 | 0.41 | 0.14 | 0.17 |
| 69 | 56 | 1.03 | 16.12 | 3.87 | 10.00 | 2.59 | 0.29 | 0.38 | 0.08 | 0.15 |
| 70 | 48 | 1.04 | 7.05 | 5.29 | 4.09 | 3.38 | 0.28 | 0.37 | 0.08 | 0.19 |
| 71 | 51 | 1.05 | 12.06 | 3.62 | 6.30 | 1.83 | 0.24 | 0.36 | 0.06 | 0.16 |
| 72 | 7 | 1.05 | 8.51 | 4.25 | 5.19 | 2.84 | 0.23 | 0.36 | 0.05 | 0.39 |
| 73 | 6 | 1.06 | 8.66 | 4.33 | 5.53 | 3.23 | 0.24 | 0.37 | 0.06 | 0.40 |
| 74 | 66 | 1.06 | 7.39 | 5.28 | 5.21 | 3.80 | 0.30 | 0.37 | 0.09 | 0.15 |
| 75 | 50 | 1.11 | 5.91 | 3.94 | 2.82 | 2.18 | 0.19 | 0.33 | 0.04 | 0.16 |
| 76 | 54 | 1.11 | 17.44 | 7.85 | 10.63 | 5.36 | 0.43 | 0.45 | 0.18 | 0.19 |
| 77 | 58 | 1.12 | 13.02 | 4.34 | 6.06 | 2.47 | 0.30 | 0.39 | 0.09 | 0.16 |
| 78 | 49 | 1.14 | 7.16 | 4.40 | 4.25 | 2.70 | 0.25 | 0.36 | 0.06 | 0.18 |
| 79 | 36 | 1.16 | 10.13 | 4.73 | 6.26 | 2.95 | 0.29 | 0.38 | 0.08 | 0.21 |
| 80 | 52 | 1.16 | 10.21 | 5.10 | 5.86 | 3.36 | 0.34 | 0.39 | 0.12 | 0.18 |
| 81 | 22 | 1.18 | 12.99 | 5.20 | 8.04 | 3.01 | 0.29 | 0.40 | 0.08 | 0.28 |
| 82 | 5 | 1.19 | 17.87 | 4.47 | 11.12 | 2.94 | 0.31 | 0.40 | 0.10 | 0.39 |
| 83 | 26 | 1.19 | 11.05 | 4.42 | 5.46 | 2.55 | 0.26 | 0.38 | 0.07 | 0.24 |
| 84 | 19 | 1.21 | 7.30 | 4.38 | 4.99 | 3.38 | 0.28 | 0.36 | 0.08 | 0.31 |
| 85 | 86 | 1.24 | 15.52 | 5.64 | 10.07 | 4.75 | | 0.42 | | 0.17 |
| 86 | 30 | 1.24 | 11.10 | 3.27 | 6.84 | 2.52 | 0.24 | 0.35 | 0.06 | 0.21 |
| 87 | 77 | 1.29 | 14.74 | 4.54 | 9.36 | 3.11 | 0.33 | 0.40 | 0.11 | 0.12 |
| 88 | 34 | 1.29 | 9.24 | 4.62 | 4.89 | 2.69 | 0.22 | 0.38 | 0.05 | 0.22 |
| 89 | 20 | 1.29 | 11.15 | 5.15 | 5.61 | 2.92 | 0.23 | 0.40 | 0.05 | 0.31 |
| 90 | 25 | 1.30 | 11.19 | 4.48 | 7.10 | 3.33 | 0.32 | 0.38 | 0.10 | 0.25 |
| 91 | 79 | 1.31 | 13.35 | 5.80 | 7.76 | 3.65 | 0.32 | 0.41 | 0.10 | 0.12 |
| 92 | 28 | 1.33 | 8.12 | 3.75 | 4.19 | 2.16 | 0.22 | 0.35 | 0.05 | 0.22 |
| 93 | 8 | 1.34 | 14.15 | 7.07 | 8.45 | 4.78 | 0.33 | 0.43 | 0.11 | 0.43 |
| 94 | 21 | 1.38 | 14.04 | 5.61 | 8.49 | 3.56 | 0.34 | 0.41 | 0.12 | 0.30 |
| 95 | 92 | 1.42 | 19.67 | 6.86 | 11.16 | 5.31 | | 0.44 | | 0.20 |
| 96 | 24 | 1.48 | 7.31 | 5.85 | 5.22 | 4.28 | 0.34 | 0.38 | 0.12 | 0.28 |

HEADINGS
L - AVERAGE LENGTH W - AVERAGE WIDTH T - AVERAGE THICKNESS
L' = MAXIMUM LENGTH PLUS AVERAGE LENGTH
W' = MAXIMUM WIDTH PLUS AVERAGE WIDTH
T' = MAXIMUM THICKNESS PLUS AVERAGE THICKNESS
SD - STANDARD DEVIATION OF PRESENTED AREAS (SQ. IN.)
VAR - VARIANCE OF PRESENTED AREAS (IN. 4TH)
AAVG↑2 - AVERAGE PRESENTED AREA SQUARED (IN. 4TH)
ICOS - AREAS CALCULATED FROM ICOSAHEDRON GAGE DATA
CALC - AREAS CALCULATED FROM APPROXIMATING RECTANGULAR PARALLELAEPIPEDS

## TABLE A-6. PERIMETER RATIOS

| FRAG NO. NEW | OLD | CD | LWP/LTP | LWP/TWP | LTP/TWP | LWP/LMAX | TWP/WMAX |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 0.42 | 1.00 | 1.00 | 1.00 | 3.14 | 3.14 |
| 2 | 95 | 0.50 | 1.08 | 1.18 | 1.08 | 3.04 | 2.91 |
| 3 | 3 | 0.64 | 1.00 | 1.00 | 1.00 | 4.03 | 4.03 |
| 4 | 70 | 0.71 | 1.01 | 2.03 | 2.00 | 2.42 | 3.03 |
| 5 | 44 | 0.72 | 1.08 | 1.47 | 1.36 | 2.83 | 2.74 |
| 6 | 62 | 0.73 | 1.25 | 1.98 | 1.58 | 3.04 | 3.12 |
| 7 | 53 | 0.76 | 1.12 | 2.14 | 1.91 | 2.81 | 2.84 |
| 8 | 41 | 0.76 | 1.05 | 1.07 | 1.02 | 2.57 | 2.47 |
| 9 | 11 | 0.76 | 1.22 | 1.87 | 1.54 | 2.70 | 2.11 |
| 10 | 57 | 0.78 | 1.07 | 1.70 | 1.59 | 2.33 | 2.22 |
| 11 | 35 | 0.79 | 1.10 | 2.42 | 2.21 | 2.29 | 2.66 |
| 12 | 90 | 0.79 | 1.07 | 1.74 | 1.63 | 2.28 | 1.71 |
| 13 | 45 | 0.80 | 1.10 | 1.50 | 1.36 | 2.52 | 2.37 |
| 14 | 89 | 0.80 | 1.01 | 1.48 | 1.47 | 2.22 | 2.60 |
| 15 | 82 | 0.81 | 1.37 | 1.42 | 1.03 | 2.90 | 2.31 |
| 16 | 40 | 0.82 | 1.00 | 1.90 | 1.90 | 2.21 | 2.32 |
| 17 | 13 | 0.83 | 1.16 | 1.19 | 1.03 | 2.78 | 2.43 |
| 18 | 46 | 0.83 | 1.25 | 1.69 | 1.36 | 2.82 | 1.97 |
| 19 | 18 | 0.83 | 1.11 | 1.69 | 1.52 | 2.25 | 2.55 |
| 20 | 73 | 0.84 | 1.36 | 1.68 | 1.23 | 3.11 | 2.15 |
| 21 | 76 | 0.84 | 1.17 | 1.69 | 1.44 | 2.39 | 2.42 |
| 22 | 63 | 0.86 | 1.09 | 2.57 | 2.35 | 2.41 | 1.96 |
| 23 | 33 | 0.86 | 1.18 | 1.35 | 1.15 | 2.40 | 1.95 |
| 24 | 74 | 0.86 | 1.16 | 1.54 | 1.33 | 2.53 | 2.59 |
| 25 | 39 | 0.86 | 1.62 | 1.70 | 1.04 | 3.21 | 2.38 |
| 26 | 65 | 0.86 | 1.18 | 2.29 | 1.93 | 2.58 | 2.13 |
| 27 | 47 | 0.87 | 1.24 | 1.68 | 1.35 | 2.68 | 2.82 |
| 28 | 69 | 0.87 | 1.14 | 2.25 | 1.97 | 2.57 | 2.10 |
| 29 | 55 | 0.88 | 1.11 | 2.89 | 2.59 | 2.40 | 2.25 |
| 30 | 64 | 0.88 | 1.67 | 1.96 | 1.17 | 3.26 | 2.04 |
| 31 | 12 | 0.88 | 1.38 | 1.57 | 1.14 | 2.93 | 2.22 |
| 32 | 27 | 0.89 | 1.11 | 2.34 | 2.11 | 2.47 | 1.96 |
| 33 | 83 | 0.89 | 1.54 | 1.63 | 1.05 | 3.23 | 2.20 |
| 34 | 78 | 0.90 | 1.21 | 2.58 | 2.13 | 2.61 | 2.48 |
| 35 | 32 | 0.90 | 1.03 | 2.09 | 2.03 | 2.17 | 2.52 |
| 36 | 60 | 0.90 | 1.06 | 1.53 | 1.45 | 2.36 | 2.56 |
| 37 | 4 | 0.91 | 1.09 | 1.36 | 1.25 | 2.56 | 2.92 |
| 38 | 67 | 0.92 | 1.29 | 2.34 | 1.81 | 2.62 | 2.25 |
| 39 | 68 | 0.92 | 1.04 | 1.06 | 1.02 | 2.27 | 3.44 |
| 40 | 85 | 0.93 | 1.16 | 2.78 | 2.40 | 2.42 | 2.21 |
| 41 | 72 | 0.93 | 1.31 | 2.05 | 1.57 | 2.57 | 2.12 |
| 42 | 9 | 0.93 | 1.14 | 2.04 | 1.79 | 2.47 | 2.59 |
| 43 | 1 | 0.94 | 1.02 | 2.88 | 2.82 | 2.52 | 3.92 |
| 44 | 17 | 0.94 | 1.14 | 2.00 | 1.75 | 2.34 | 2.38 |
| 45 | 88 | 0.95 | 1.16 | 2.44 | 2.10 | 2.37 | 2.05 |
| 46 | 43 | 0.95 | 1.16 | 3.74 | 3.22 | 2.68 | 2.31 |
| 47 | 16 | 0.95 | 1.05 | 2.46 | 2.33 | 2.12 | 2.73 |
| 48 | 80 | 0.96 | 1.09 | 3.03 | 2.77 | 2.33 | 2.55 |
| 49 | 31 | 0.96 | 1.10 | 1.31 | 1.18 | 2.56 | 2.34 |
| 50 | 29 | 0.96 | 1.04 | 1.96 | 1.88 | 2.31 | 2.20 |

TABLE A-6. PERIMETER RATIOS (Continued)

| FRAG NO. NEW | FRAG NO. OLD | CD | LWP/LTP | LWP/TWP | LTP/TWP | LWP/LMAX | TWP/WMAX |
|---|---|---|---|---|---|---|---|
| 51 | 37 | 0.96 | 1.13 | 1.99 | 1.76 | 2.37 | 2.29 |
| 52 | 61 | 0.96 | 1.12 | 2.46 | 2.19 | 2.30 | 2.20 |
| 53 | 14 | 0.96 | 1.25 | 1.48 | 1.19 | 2.88 | 2.59 |
| 54 | 10 | 0.97 | 1.45 | 2.29 | 1.59 | 2.32 | 2.08 |
| 55 | 87 | 0.98 | 1.35 | 2.41 | 1.78 | 2.52 | 1.80 |
| 56 | 71 | 0.98 | 1.15 | 2.85 | 2.46 | 2.36 | 2.22 |
| 57 | 15 | 0.98 | 1.16 | 1.63 | 1.41 | 2.70 | 2.22 |
| 58 | 38 | 0.98 | 1.08 | 1.90 | 1.76 | 2.23 | 2.10 |
| 59 | 42 | 0.98 | 1.08 | 2.43 | 2.25 | 2.46 | 2.65 |
| 60 | 75 | 0.99 | 1.10 | 2.07 | 1.88 | 2.41 | 2.51 |
| 61 | 96 | 0.99 | 1.39 | 1.58 | 1.14 | 2.98 | 2.29 |
| 62 | 91 | 0.99 | 1.42 | 2.29 | 1.61 | 2.69 | 2.11 |
| 63 | 81 | 0.99 | 1.00 | 2.64 | 2.64 | 2.32 | 2.20 |
| 64 | 84 | 1.00 | 1.36 | 3.41 | 2.52 | 2.64 | 2.16 |
| 65 | 93 | 1.01 | 1.31 | 3.95 | 3.02 | 2.85 | 1.67 |
| 66 | 94 | 1.02 | 1.26 | 1.83 | 1.45 | 2.70 | 2.48 |
| 67 | 23 | 1.02 | 1.14 | 1.66 | 1.46 | 2.35 | 2.58 |
| 68 | 59 | 1.03 | 1.54 | 1.64 | 1.06 | 3.04 | 2.16 |
| 69 | 56 | 1.03 | 1.03 | 3.25 | 3.14 | 2.14 | 2.38 |
| 70 | 48 | 1.04 | 1.39 | 1.42 | 1.02 | 2.90 | 2.28 |
| 71 | 51 | 1.05 | 1.03 | 2.89 | 2.81 | 2.16 | 2.64 |
| 72 | 7 | 1.05 | 1.20 | 1.79 | 1.50 | 2.66 | 2.50 |
| 73 | 6 | 1.06 | 1.20 | 1.71 | 1.42 | 2.51 | 2.21 |
| 74 | 66 | 1.06 | 1.47 | 1.60 | 1.09 | 2.78 | 2.34 |
| 75 | 50 | 1.11 | 1.26 | 1.44 | 1.15 | 3.29 | 2.59 |
| 76 | 54 | 1.11 | 1.22 | 2.10 | 1.72 | 2.51 | 2.16 |
| 77 | 58 | 1.12 | 1.13 | 2.14 | 1.89 | 2.37 | 2.30 |
| 78 | 49 | 1.14 | 1.35 | 1.88 | 1.40 | 2.98 | 2.42 |
| 79 | 36 | 1.16 | 1.09 | 2.14 | 1.97 | 2.23 | 2.19 |
| 80 | 52 | 1.16 | 1.34 | 1.92 | 1.43 | 2.67 | 2.16 |
| 81 | 22 | 1.18 | 1.00 | 2.78 | 2.78 | 2.17 | 2.22 |
| 82 | 5 | 1.19 | 1.04 | 2.90 | 2.80 | 2.10 | 2.60 |
| 83 | 26 | 1.19 | 1.27 | 2.22 | 1.75 | 2.62 | 2.22 |
| 84 | 19 | 1.21 | 1.32 | 1.66 | 1.26 | 2.87 | 2.28 |
| 85 | 86 | 1.24 | 1.31 | 2.10 | 1.61 | 2.61 | 2.15 |
| 86 | 30 | 1.24 | 1.09 | 2.25 | 2.07 | 2.26 | 2.27 |
| 87 | 77 | 1.29 | 1.19 | 2.74 | 2.31 | 2.30 | 2.35 |
| 88 | 34 | 1.29 | 1.19 | 1.91 | 1.61 | 2.64 | 2.31 |
| 89 | 20 | 1.29 | 1.20 | 1.87 | 1.55 | 2.36 | 2.21 |
| 90 | 25 | 1.30 | 1.24 | 1.84 | 1.48 | 2.36 | 2.40 |
| 91 | 79 | 1.31 | 1.41 | 2.65 | 1.88 | 2.82 | 2.12 |
| 92 | 28 | 1.33 | 1.06 | 1.70 | 1.61 | 2.54 | 2.64 |
| 93 | 8 | 1.34 | 1.18 | 1.86 | 1.57 | 2.52 | 2.16 |
| 94 | 21 | 1.38 | 1.11 | 2.30 | 2.07 | 2.21 | 2.20 |
| 95 | 92 | 1.42 | 1.38 | 2.20 | 1.60 | 2.72 | 2.07 |
| 96 | 24 | 1.48 | 1.34 | 1.64 | 1.23 | 2.98 | 2.16 |

HEADINGS
LWP - PERIMETER IN LW PLANE (IN.)
LTP - PERIMETER IN LT PLANE (IN.)
TWP - PERIMETER IN TW PLANE (IN.)
LMAX - MAXIMUM LENGTH (IN.)
WMAX - MAXIMUM WIDTH (IN.)

## TABLE A-7. MOMENT OF INERTIA RATIOS

| FRAG NO. NEW | FRAG NO. OLD | WEIGHT GRAINS | CD | ------ GRAINS-IN↑2 ------ IT | IW | IL | IT/IW | IT/IL | IW/IL | IT↑2/ IL*IW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 1030.4 | 0.42 | SPHERE: ALL RATIOS EQUAL 1.00 | | | | | | |
| 2 | 95 | 15595.1 | 0.50 | 17687.4 | 14618.3 | 7327.6 | 1.21 | 2.41 | 1.99 | 2.92 |
| 3 | 3 | 835.0 | 0.64 | CUBE: ALL RATIOS EQUAL 1.00 | | | | | | |
| 4 | 70 | 561.2 | 0.71 | 128.1 | 108.6 | 26.3 | 1.18 | 4.87 | 4.13 | 5.74 |
| 5 | 44 | 354.0 | 0.72 | 50.2 | 37.3 | 16.0 | 1.35 | 3.13 | 2.33 | 4.22 |
| 6 | 62 | 489.3 | 0.73 | 152.1 | 133.7 | 21.6 | 1.14 | 7.04 | 6.19 | 8.00 |
| 7 | 53 | 395.1 | 0.76 | 90.2 | 75.3 | 17.3 | 1.20 | 5.21 | 4.35 | 6.24 |
| 8 | 41 | 333.2 | 0.76 | 51.4 | 34.6 | 18.8 | 1.48 | 2.74 | 1.84 | 4.06 |
| 9 | 11 | 128.6 | 0.76 | 15.6 | 13.1 | 2.8 | 1.19 | 5.52 | 4.63 | 6.58 |
| 10 | 57 | 461.7 | 0.78 | 89.6 | 67.1 | 26.7 | 1.34 | 3.36 | 2.52 | 4.50 |
| 11 | 35 | 302.8 | 0.79 | 100.2 | 91.6 | 9.6 | 1.09 | 10.46 | 9.56 | 11.44 |
| 12 | 90 | 2006.2 | 0.79 | 1130.2 | 993.9 | 198.1 | 1.14 | 5.71 | 5.02 | 6.49 |
| 13 | 45 | 354.9 | 0.80 | 57.1 | 44.0 | 15.9 | 1.30 | 3.58 | 2.76 | 4.65 |
| 14 | 89 | 2005.7 | 0.80 | 1180.0 | 1078.5 | 169.2 | 1.09 | 6.97 | 6.37 | 7.63 |
| 15 | 82 | 804.8 | 0.81 | 252.8 | 175.2 | 84.7 | 1.44 | 2.99 | 2.07 | 4.31 |
| 16 | 40 | 325.7 | 0.82 | 63.0 | 54.3 | 10.9 | 1.16 | 5.80 | 5.00 | 6.73 |
| 17 | 13 | 130.8 | 0.83 | 9.3 | 5.6 | 4.2 | 1.65 | 2.20 | 1.34 | 3.63 |
| 18 | 46 | 357.9 | 0.83 | 65.0 | 51.6 | 15.8 | 1.26 | 4.11 | 3.26 | 5.18 |
| 19 | 18 | 158.6 | 0.83 | 28.0 | 26.2 | 2.4 | 1.07 | 11.80 | 11.02 | 12.64 |
| 20 | 73 | 655.4 | 0.84 | 205.9 | 141.8 | 68.1 | 1.45 | 3.03 | 2.08 | 4.39 |
| 21 | 76 | 713.9 | 0.84 | 252.2 | 195.1 | 61.9 | 1.29 | 4.08 | 3.15 | 5.27 |
| 22 | 63 | 490.9 | 0.86 | 206.6 | 181.3 | 27.1 | 1.14 | 7.62 | 6.69 | 8.68 |
| 23 | 33 | 280.2 | 0.86 | 36.7 | 29.4 | 9.5 | 1.25 | 3.84 | 3.08 | 4.80 |
| 24 | 74 | 656.0 | 0.86 | 232.3 | 200.0 | 37.6 | 1.16 | 6.17 | 5.31 | 7.17 |
| 25 | 39 | 323.9 | 0.86 | 67.5 | 46.1 | 22.4 | 1.46 | 3.01 | 2.06 | 4.41 |
| 26 | 65 | 505.0 | 0.86 | 151.5 | 138.8 | 17.6 | 1.09 | 8.62 | 7.90 | 9.41 |
| 27 | 47 | 359.2 | 0.87 | 73.3 | 59.7 | 15.7 | 1.23 | 4.66 | 3.79 | 5.72 |
| 28 | 69 | 556.2 | 0.87 | 197.0 | 169.0 | 31.3 | 1.17 | 6.29 | 5.39 | 7.33 |
| 29 | 55 | 432.7 | 0.88 | 147.8 | 131.2 | 18.7 | 1.13 | 7.90 | 7.01 | 8.90 |
| 30 | 64 | 495.1 | 0.88 | 206.3 | 165.7 | 42.0 | 1.24 | 4.92 | 3.95 | 6.12 |
| 31 | 12 | 128.8 | 0.88 | 13.7 | 7.0 | 7.0 | 1.97 | 1.97 | 1.00 | 3.88 |
| 32 | 27 | 241.6 | 0.89 | 46.7 | 39.9 | 7.7 | 1.17 | 6.07 | 5.18 | 7.10 |
| 33 | 83 | 833.7 | 0.89 | 314.0 | 180.4 | 138.7 | 1.74 | 2.26 | 1.30 | 3.94 |
| 34 | 78 | 767.0 | 0.90 | 532.4 | 503.7 | 33.9 | 1.06 | 15.72 | 14.87 | 16.61 |
| 35 | 32 | 277.4 | 0.90 | 89.2 | 84.0 | 6.3 | 1.06 | 14.17 | 13.33 | 15.05 |
| 36 | 60 | 484.1 | 0.90 | 94.0 | 70.5 | 28.1 | 1.33 | 3.34 | 2.51 | 4.45 |
| 37 | 4 | 110.7 | 0.91 | 9.8 | 7.6 | 2.5 | 1.28 | 3.97 | 3.10 | 5.09 |
| 38 | 67 | 531.9 | 0.92 | 205.7 | 176.6 | 25.6 | 1.15 | 6.94 | 6.02 | 7.99 |
| 39 | 68 | 547.9 | 0.92 | 146.1 | 119.1 | 31.4 | 1.23 | 4.65 | 3.79 | 5.70 |
| 40 | 85 | 1617.7 | 0.93 | 1145.9 | 993.3 | 173.7 | 1.15 | 6.60 | 5.72 | 7.61 |
| 41 | 72 | 651.7 | 0.93 | 305.2 | 240.6 | 66.8 | 1.27 | 4.57 | 3.60 | 5.80 |
| 42 | 9 | 121.5 | 0.93 | 14.8 | 12.4 | 2.7 | 1.19 | 5.57 | 4.66 | 6.65 |
| 43 | 1 | 159.3 | 0.94 | 23.6 | 23.3 | 2.0 | 1.02 | 11.67 | 11.49 | 11.86 |
| 44 | 17 | 155.5 | 0.94 | 25.1 | 22.1 | 3.4 | 1.14 | 7.34 | 6.45 | 8.35 |
| 45 | 88 | 1973.2 | 0.95 | 2611.2 | 2382.4 | 244.7 | 1.10 | 10.67 | 9.73 | 11.69 |
| 46 | 43 | 352.8 | 0.95 | 213.1 | 199.0 | 14.7 | 1.07 | 14.50 | 13.54 | 15.53 |
| 47 | 16 | 150.1 | 0.95 | 38.2 | 36.3 | 2.2 | 1.05 | 17.72 | 16.86 | 18.63 |
| 48 | 80 | 777.0 | 0.96 | 539.4 | 510.2 | 34.3 | 1.06 | 15.72 | 14.87 | 16.61 |
| 49 | 31 | 268.9 | 0.96 | 35.2 | 28.1 | 9.1 | 1.25 | 3.89 | 3.10 | 4.86 |
| 50 | 29 | 248.7 | 0.96 | 42.5 | 35.6 | 8.0 | 1.19 | 5.32 | 4.45 | 6.35 |

## TABLE A-7. MOMENT OF INERTIA RATIOS (Continued)

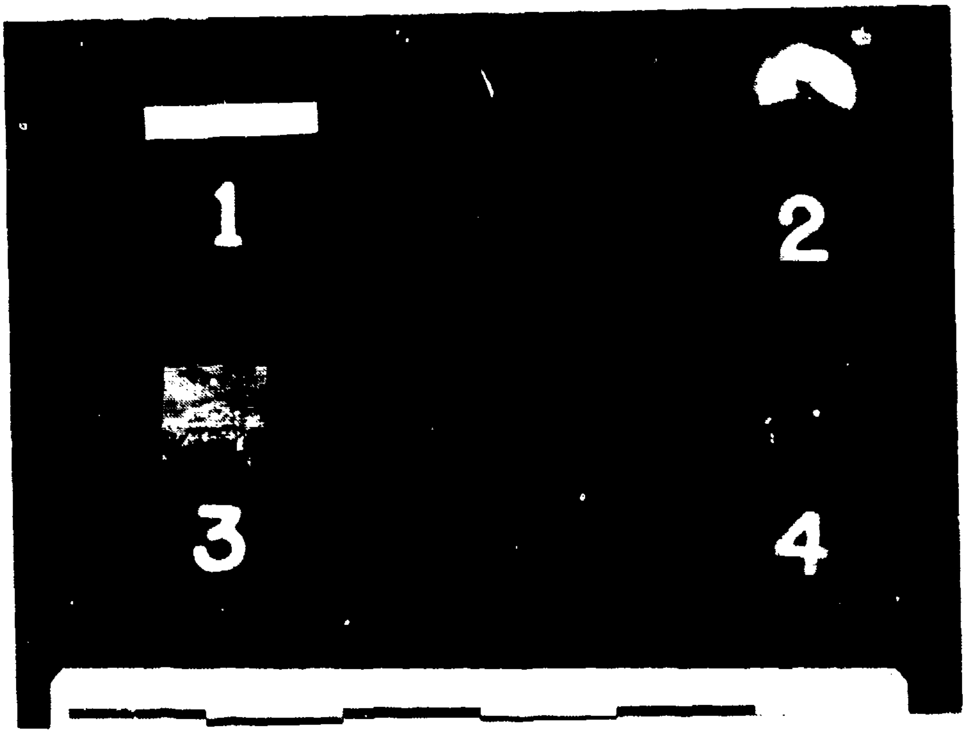
| FRAG NEW | NO. OLD | WEIGHT GRAINS | CD | ------ GRAINS-IN↑2 ------ IT | IW | IL | IT/IW | IT/IL | IW/IL | IT↑2/ IL*IW |
|---|---|---|---|---|---|---|---|---|---|---|
| 51 | 37 | 309.4 | 0.96 | 63.2 | 51.2 | 13.3 | 1.23 | 4.75 | 3.85 | 5.86 |
| 52 | 61 | 486.7 | 0.96 | 211.7 | 179.5 | 33.5 | 1.18 | 6.31 | 5.35 | 7.44 |
| 53 | 14 | 132.9 | 0.96 | 13.8 | 11.3 | 3.0 | 1.23 | 4.64 | 3.78 | 5.68 |
| 54 | 10 | 121.8 | 0.97 | 19.6 | 14.7 | 5.0 | 1.34 | 3.90 | 2.92 | 5.21 |
| 55 | 87 | 1799.4 | 0.98 | 1848.9 | 1640.9 | 223.9 | 1.13 | 8.26 | 7.33 | 9.31 |
| 56 | 71 | 608.4 | 0.98 | 309.3 | 269.3 | 42.2 | 1.15 | 7.33 | 6.38 | 8.41 |
| 57 | 15 | 135.5 | 0.98 | 13.2 | 9.3 | 4.3 | 1.41 | 3.10 | 2.19 | 4.39 |
| 58 | 38 | 313.1 | 0.98 | 56.9 | 44.9 | 13.6 | 1.27 | 4.17 | 3.30 | 5.28 |
| 59 | 42 | 335.0 | 0.98 | 73.0 | 64.0 | 11.1 | 1.14 | 6.59 | 5.77 | 7.52 |
| 60 | 75 | 668.5 | 0.99 | 281.3 | 247.9 | 37.9 | 1.13 | 7.43 | 6.54 | 8.43 |
| 61 | 96 | 23413.5 | 0.99 | 56972.9 | 35794.6 | 23931.7 | 1.59 | 2.38 | 1.50 | 3.79 |
| 62 | 91 | 2035.6 | 0.99 | 1859.2 | 1537.3 | 343.1 | 1.21 | 5.42 | 4.48 | 6.55 |
| 63 | 81 | 782.2 | 0.99 | 417.2 | 378.3 | 44.6 | 1.10 | 9.36 | 8.48 | 10.32 |
| 64 | 84 | 866.3 | 1.00 | 708.2 | 651.6 | 60.3 | 1.09 | 11.74 | 10.80 | 12.76 |
| 65 | 93 | 3148.0 | 1.01 | 5000.1 | 4427.6 | 608.0 | 1.13 | 8.22 | 7.28 | 9.29 |
| 66 | 94 | 3278.2 | 1.02 | 2832.9 | 2343.4 | 581.4 | 1.21 | 4.87 | 4.03 | 5.89 |
| 67 | 23 | 213.8 | 1.02 | 28.0 | 22.1 | 6.9 | 1.27 | 4.04 | 3.19 | 5.12 |
| 68 | 59 | 483.2 | 1.03 | 143.3 | 104.0 | 41.2 | 1.38 | 3.48 | 2.53 | 4.80 |
| 69 | 56 | 455.9 | 1.03 | 251.1 | 238.4 | 14.6 | 1.05 | 17.14 | 16.27 | 18.06 |
| 70 | 48 | 360.2 | 1.04 | 67.5 | 44.1 | 25.2 | 1.53 | 2.68 | 1.75 | 4.11 |
| 71 | 51 | 390.2 | 1.05 | 141.8 | 131.0 | 12.6 | 1.08 | 11.21 | 10.36 | 12.13 |
| 72 | 7 | 115.2 | 1.05 | 12.0 | 9.7 | 2.5 | 1.23 | 4.73 | 3.84 | 5.83 |
| 73 | 6 | 113.2 | 1.06 | 11.8 | 9.6 | 2.5 | 1.23 | 4.73 | 3.84 | 5.83 |
| 74 | 66 | 519.6 | 1.06 | 128.2 | 86.4 | 44.9 | 1.48 | 2.86 | 1.93 | 4.24 |
| 75 | 50 | 381.8 | 1.11 | 66.2 | 47.1 | 21.6 | 1.41 | 3.06 | 2.18 | 4.30 |
| 76 | 54 | 404.6 | 1.11 | 162.2 | 135.3 | 27.7 | 1.20 | 5.85 | 4.88 | 7.01 |
| 77 | 58 | 464.8 | 1.12 | 189.8 | 171.8 | 20.0 | 1.10 | 9.50 | 8.60 | 10.50 |
| 78 | 49 | 370.3 | 1.14 | 71.9 | 53.2 | 20.7 | 1.35 | 3.47 | 2.56 | 4.69 |
| 79 | 36 | 304.8 | 1.16 | 69.6 | 57.7 | 13.0 | 1.21 | 5.35 | 4.43 | 6.45 |
| 80 | 52 | 393.3 | 1.16 | 104.9 | 84.7 | 21.8 | 1.24 | 4.81 | 3.88 | 5.95 |
| 81 | 22 | 203.7 | 1.18 | 44.3 | 38.4 | 6.4 | 1.15 | 6.97 | 6.05 | 8.04 |
| 82 | 5 | 112.3 | 1.19 | 25.5 | 24.0 | 1.6 | 1.06 | 16.18 | 15.28 | 17.14 |
| 83 | 26 | 239.4 | 1.19 | 52.1 | 45.3 | 7.6 | 1.15 | 6.88 | 5.98 | 7.91 |
| 84 | 19 | 161.1 | 1.21 | 18.3 | 13.7 | 5.1 | 1.33 | 3.58 | 2.69 | 4.78 |
| 85 | 86 | 1650.8 | 1.24 | 1696.2 | 1504.2 | 204.2 | 1.13 | 8.31 | 7.37 | 9.37 |
| 86 | 30 | 255.1 | 1.24 | 66.8 | 61.9 | 5.8 | 1.08 | 11.52 | 10.69 | 12.42 |
| 87 | 77 | 719.1 | 1.29 | 443.4 | 407.0 | 40.3 | 1.09 | 11.01 | 10.10 | 11.99 |
| 88 | 34 | 291.1 | 1.29 | 59.4 | 48.1 | 12.4 | 1.24 | 4.78 | 3.87 | 5.91 |
| 89 | 20 | 178.2 | 1.29 | 30.4 | 25.3 | 5.6 | 1.20 | 5.48 | 4.55 | 6.59 |
| 90 | 25 | 236.4 | 1.30 | 51.4 | 44.7 | 7.4 | 1.15 | 6.92 | 6.01 | 7.97 |
| 91 | 79 | 776.7 | 1.31 | 407.1 | 344.3 | 66.6 | 1.18 | 6.11 | 5.17 | 7.23 |
| 92 | 28 | 244.8 | 1.33 | 41.8 | 35.0 | 7.9 | 1.19 | 5.32 | 4.45 | 6.35 |
| 93 | 8 | 119.7 | 1.34 | 18.0 | 14.4 | 3.7 | 1.24 | 4.91 | 3.95 | 6.11 |
| 94 | 21 | 188.5 | 1.38 | 41.0 | 35.5 | 5.8 | 1.15 | 7.01 | 6.08 | 8.09 |
| 95 | 92 | 2763.3 | 1.42 | 4775.9 | 4268.9 | 529.3 | 1.12 | 9.02 | 8.07 | 10.10 |
| 96 | 24 | 214.6 | 1.48 | 29.3 | 18.2 | 11.8 | 1.61 | 2.49 | 1.55 | 4.00 |

HEADINGS
IT - MOMENT OF INERTIA ABOUT THE T AXIS
IW - MOMENT OF INERTIA ABOUT THE W AXIS
IL - MOMENT OF INERTIA ABOUT THE L AXIS
IT/IW - RATIO OF IT TO IW
IT/IL - RATIO OF IT TO IL
IW/IL - RATIO OF IW TO IL
IT↑2/(IL*IW) - RATIO OF IT↑2 TO IL*IW

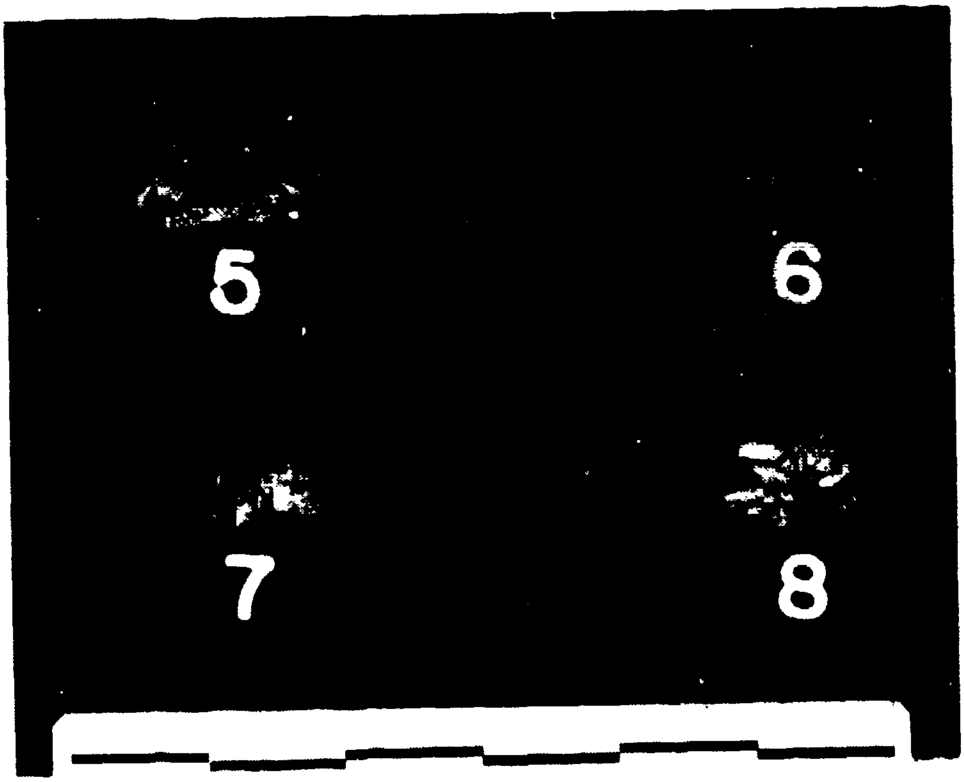
# APPENDIX B

# FRAGMENT PHOTOGRAPHS

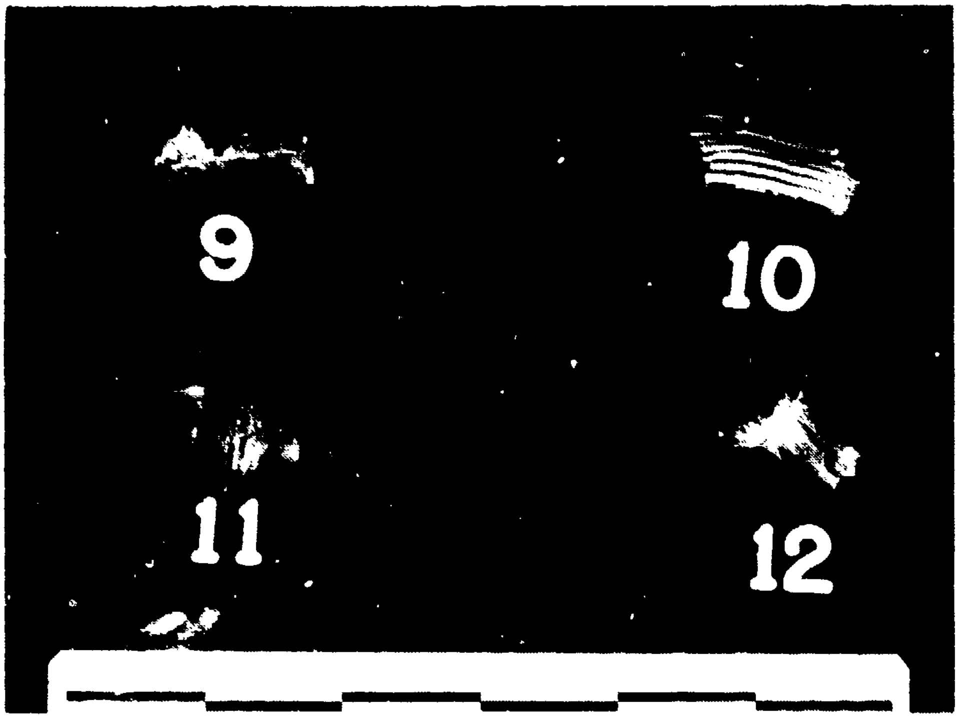
Photographs of fragments 1 through 96 are contained in this Appendix. The photographs show the shapes and sizes of the fragments. Comparison with Appendixes C and D present a good description of the overall fragment shapes and sizes.



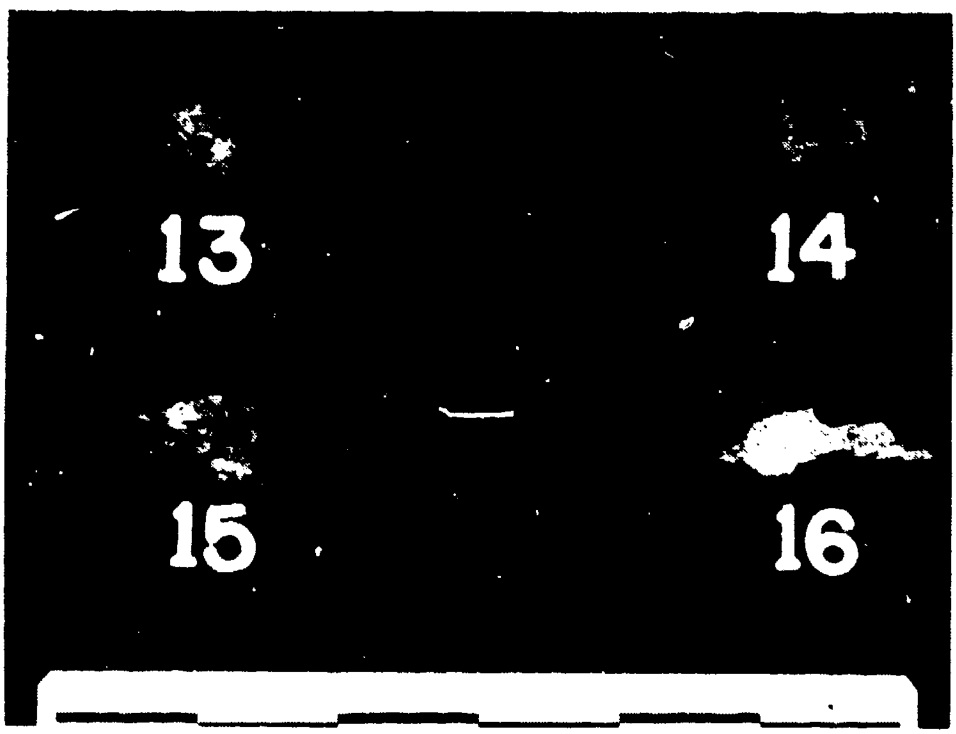

FRAGMENTS 1 THROUGH 4



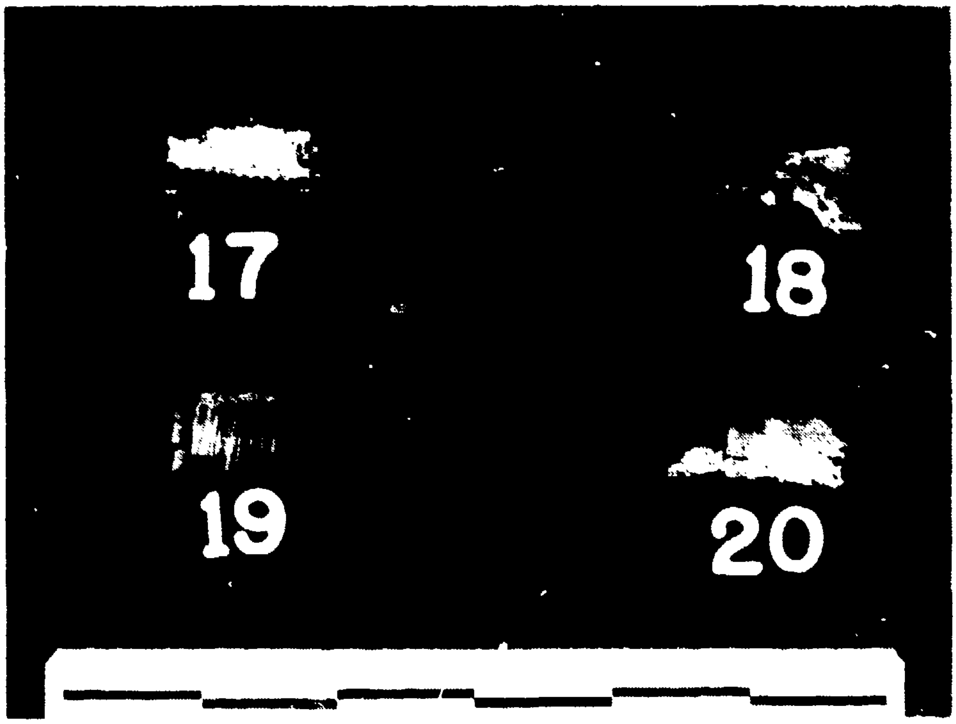

FRAGMENTS 5 THROUGH 8



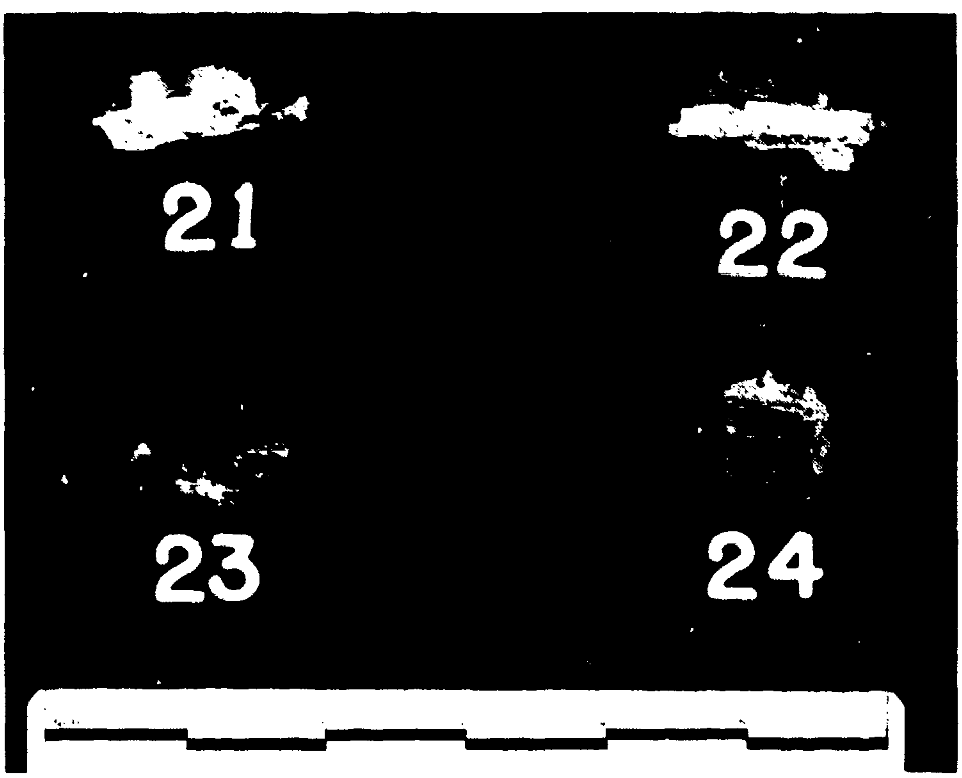

FRAGMENTS 9 THROUGH 12



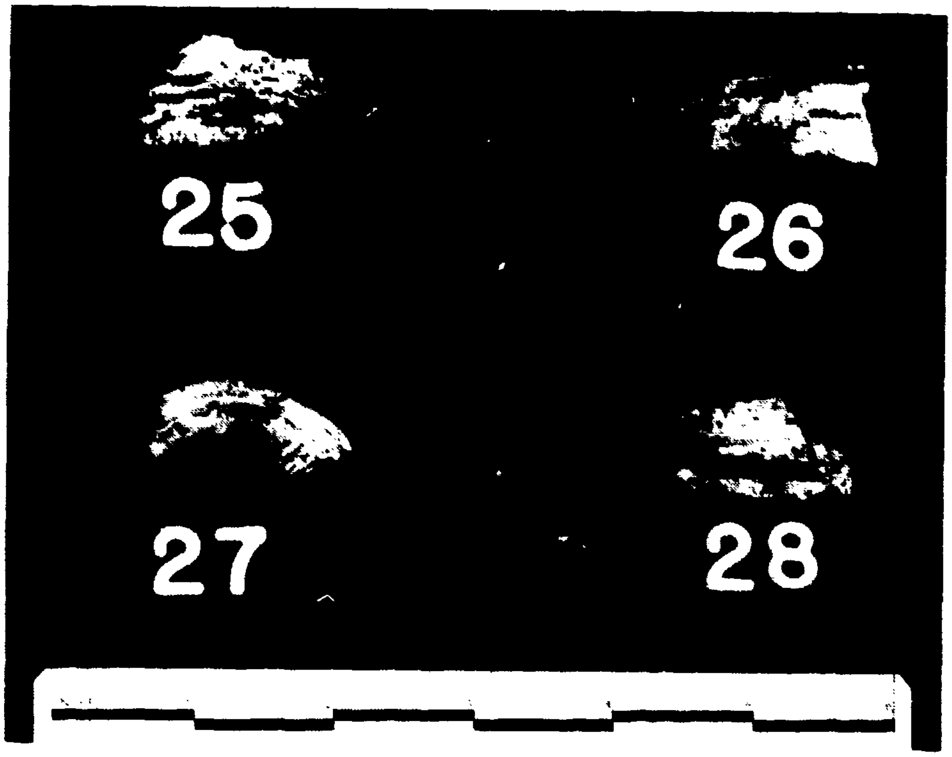

FRAGMENTS 13 THROUGH 16



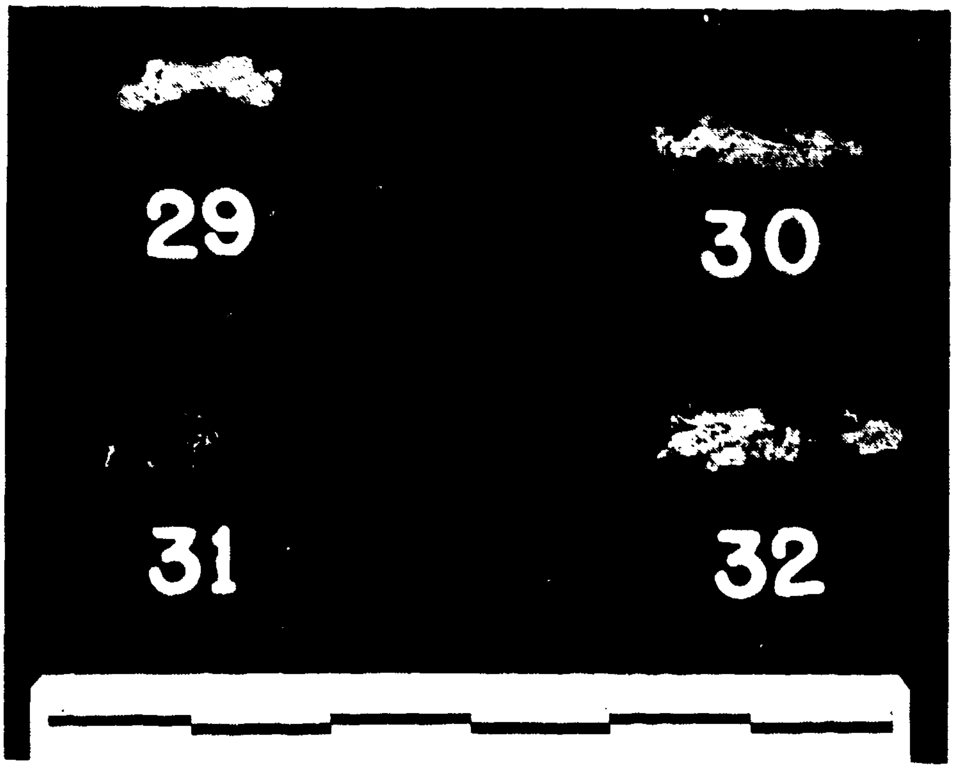

FRAGMENTS 17 THROUGH 20



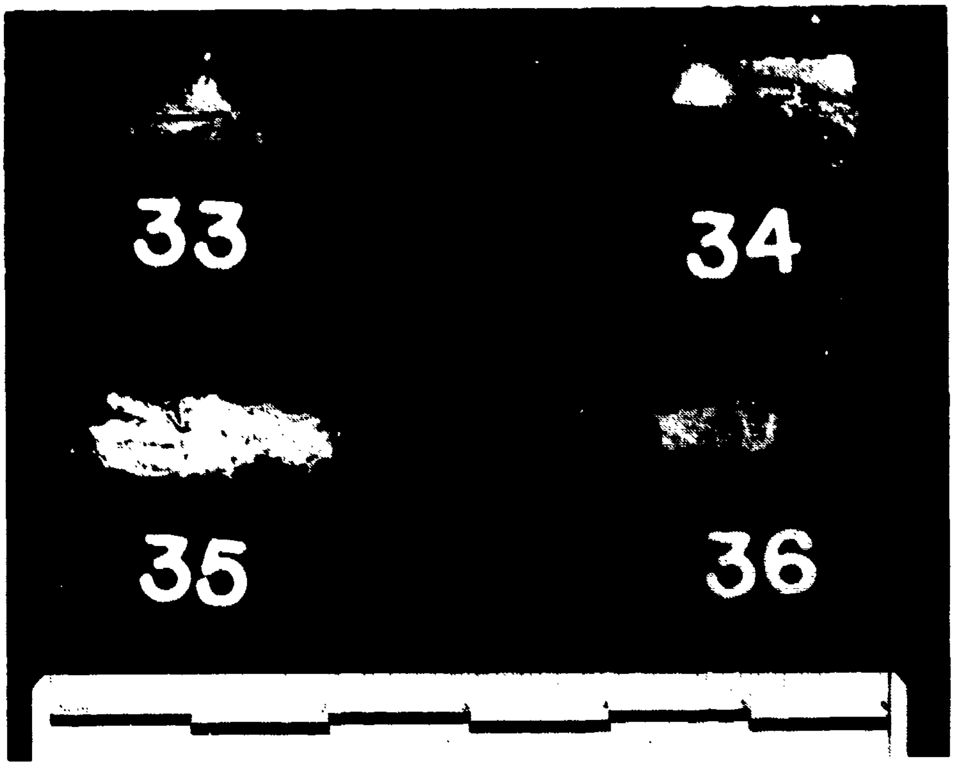

FRAGMENTS 21 THROUGH 24



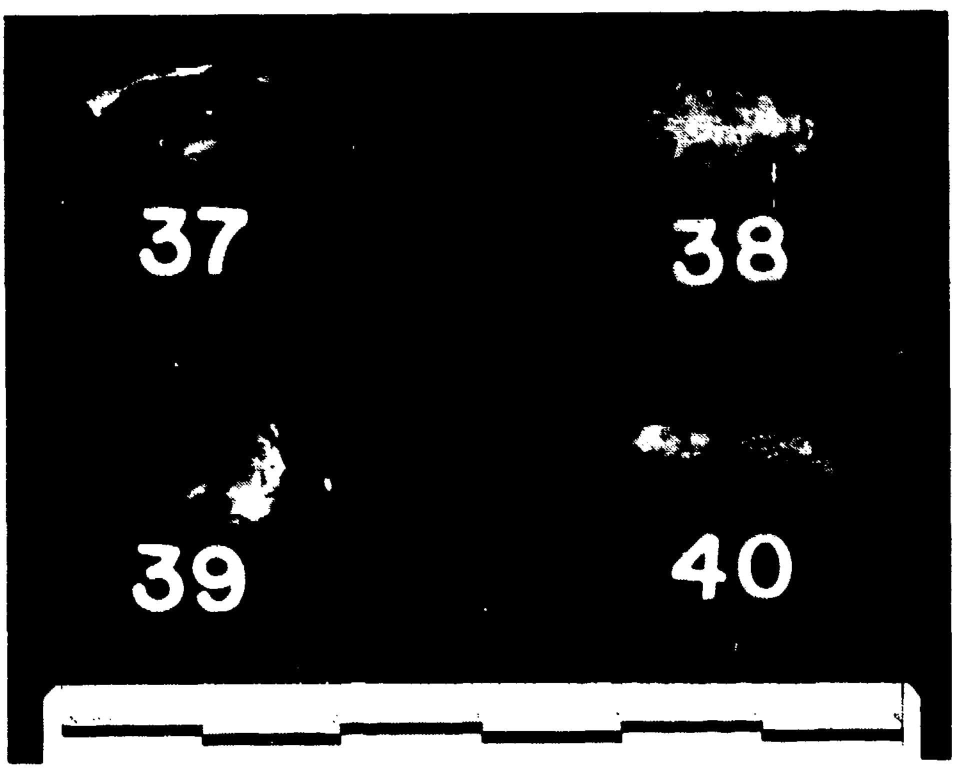

FRAGMENTS 25 THROUGH 28



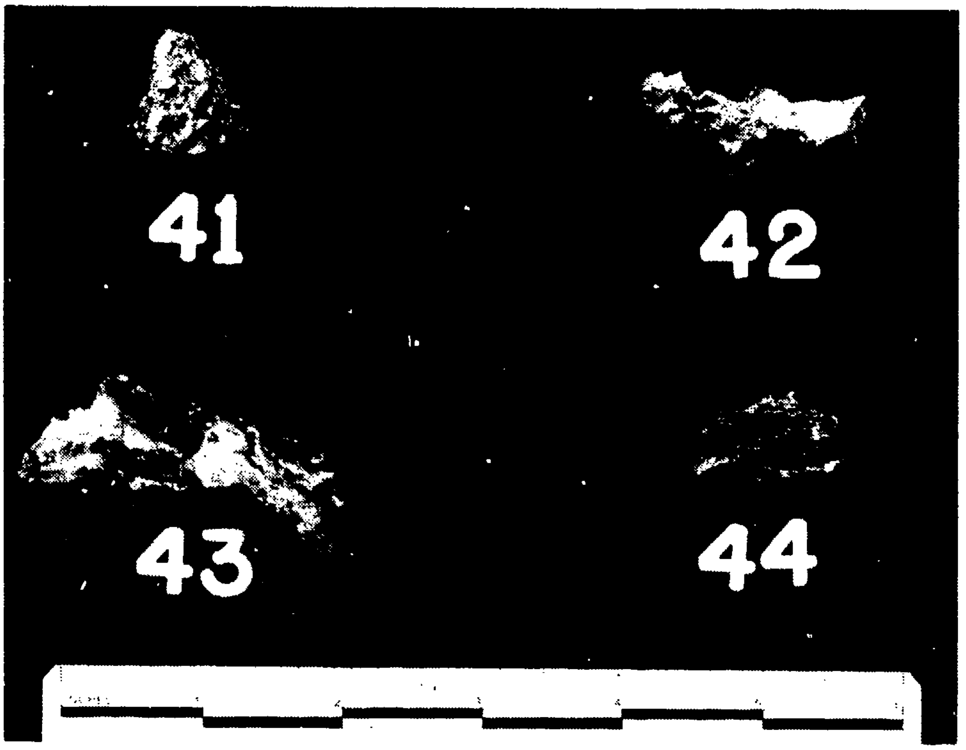

FRAGMENTS 29 THROUGH 32



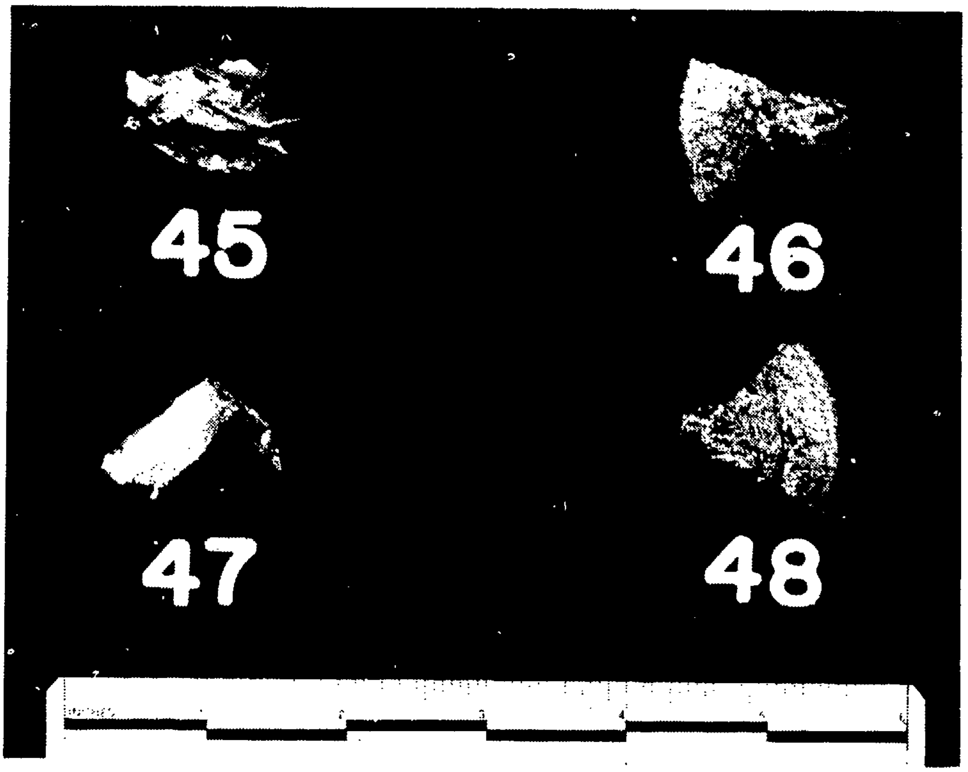

FRAGMENTS 33 THROUGH 36



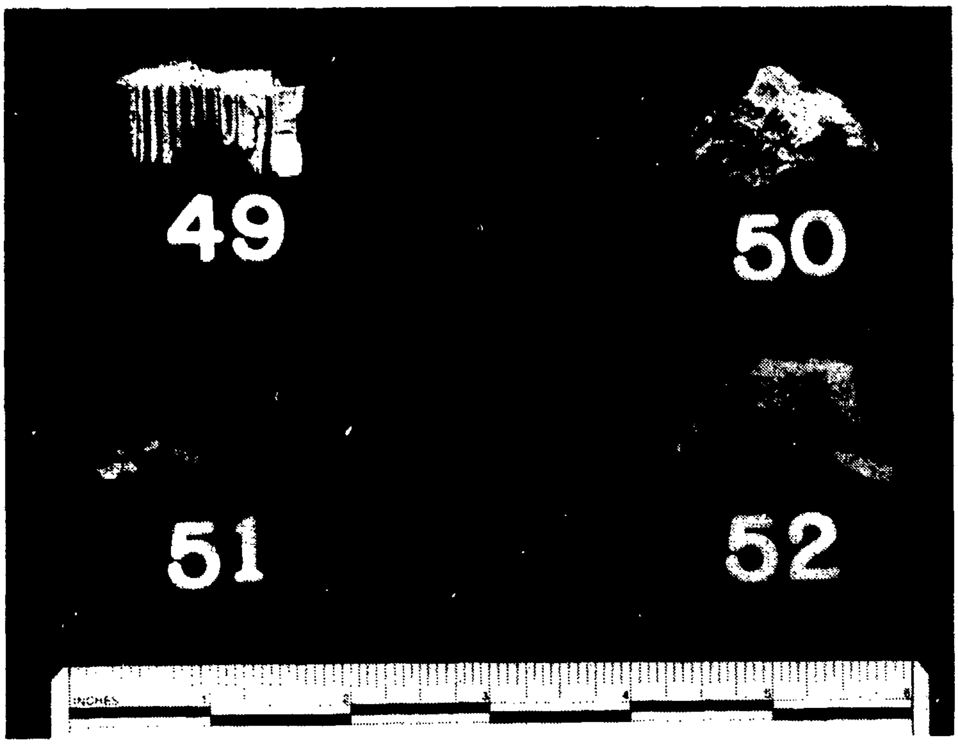

FRAGMENTS 37 THROUGH 40



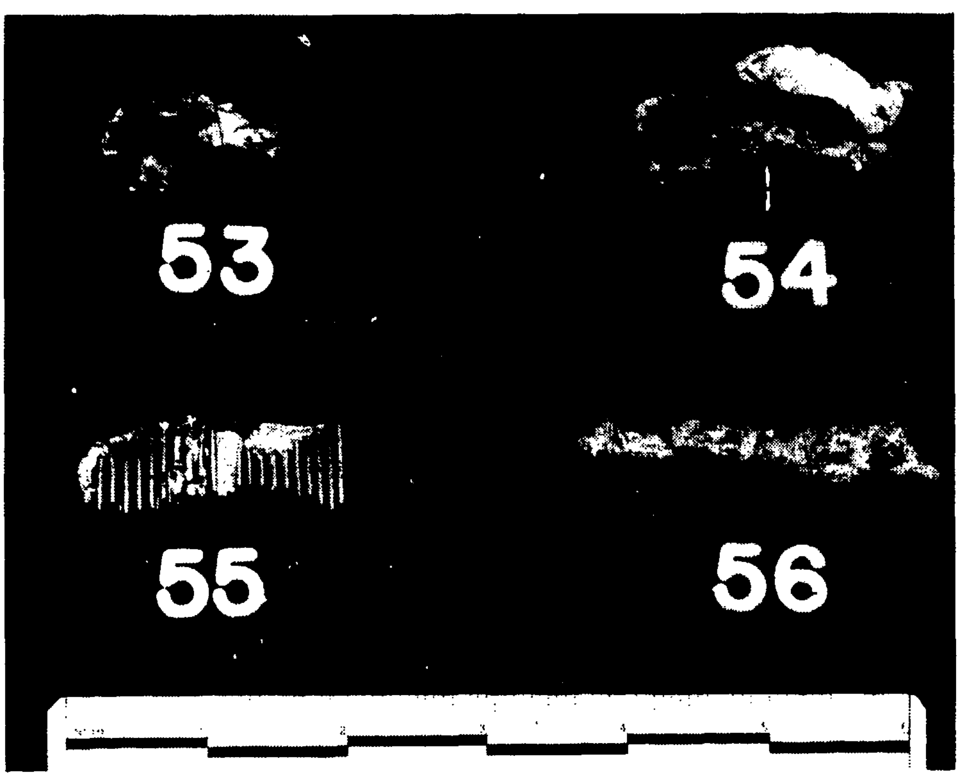

FRAGMENTS 41 THROUGH 44



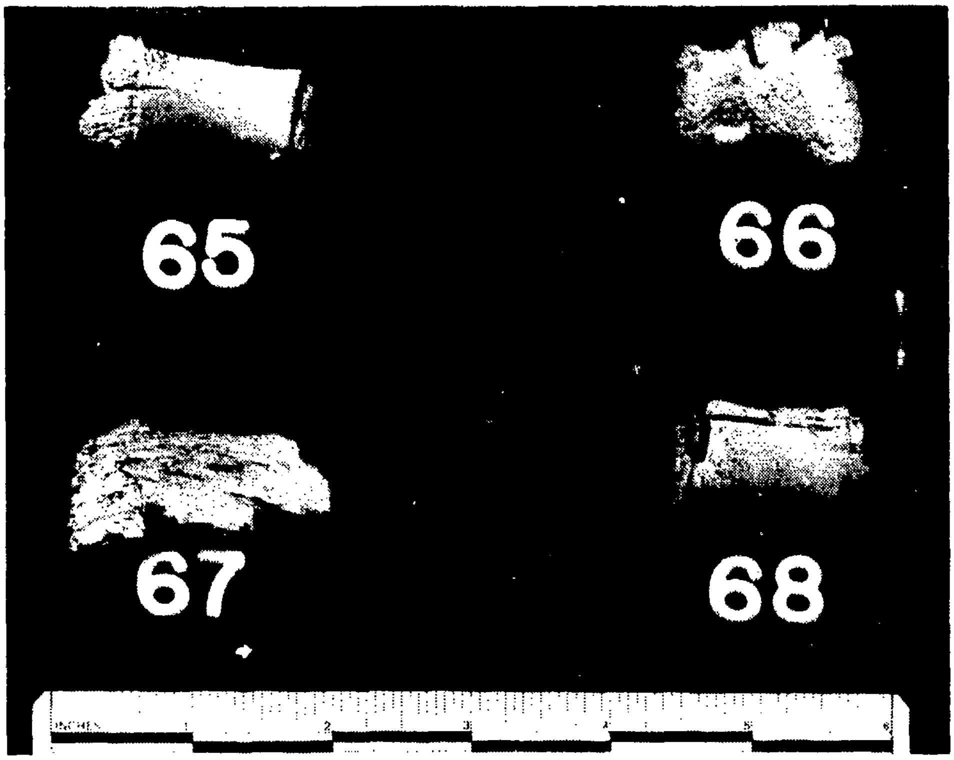

FRAGMENTS 45 THROUGH 48



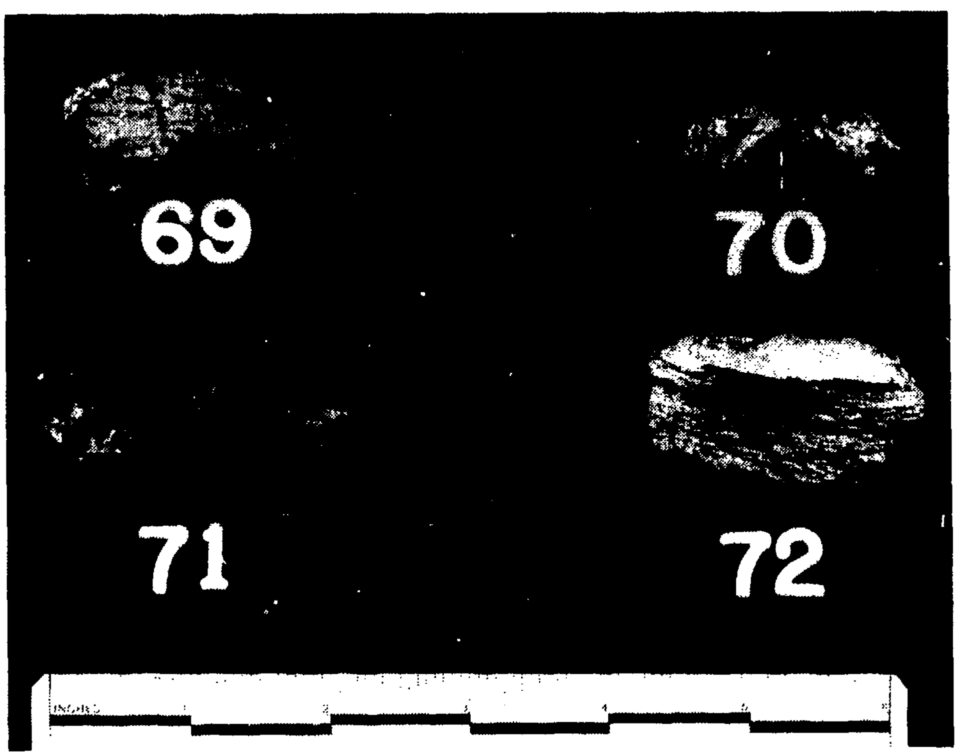

FRAGMENTS 49 THROUGH 52



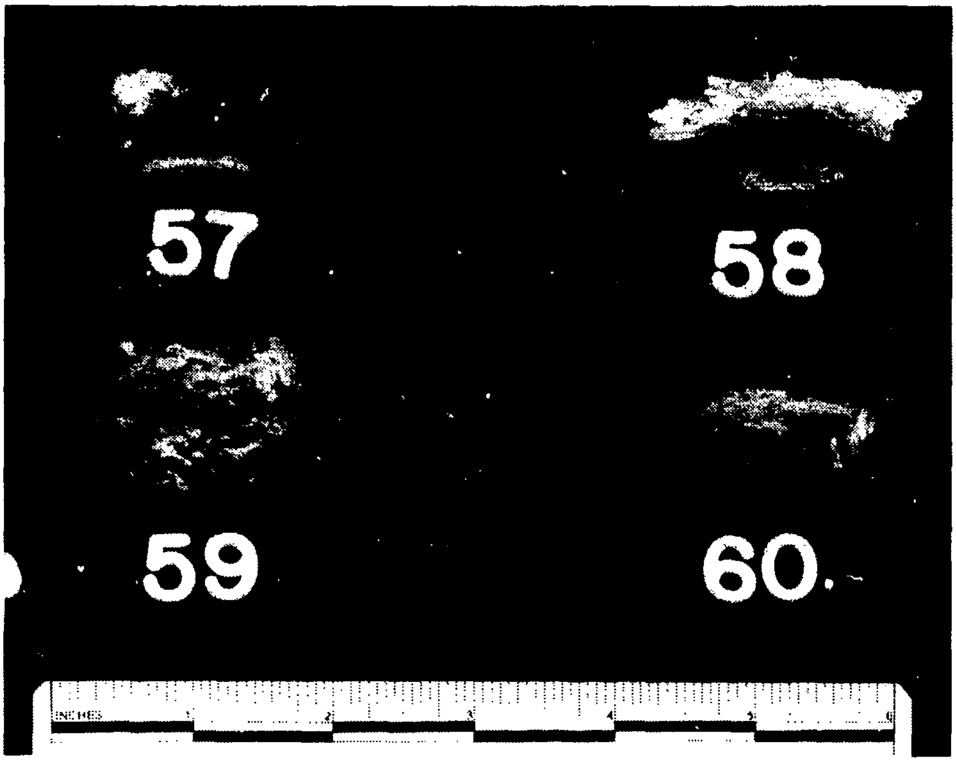

FRAGMENTS 53 THROUGH 56



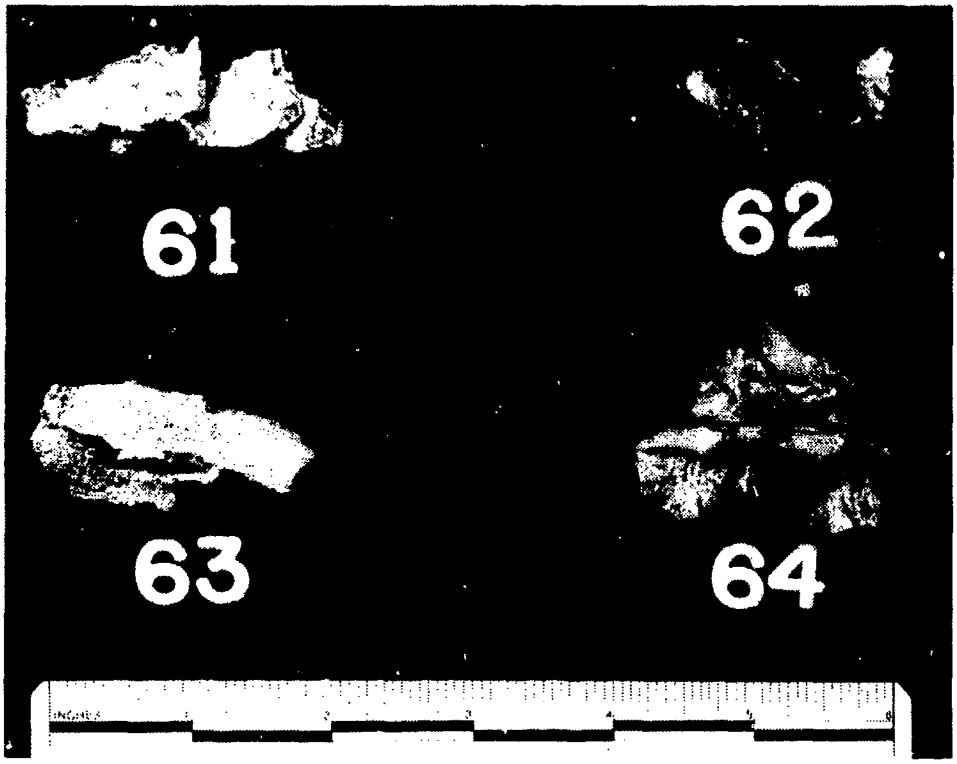

FRAGMENTS 65 THROUGH 68



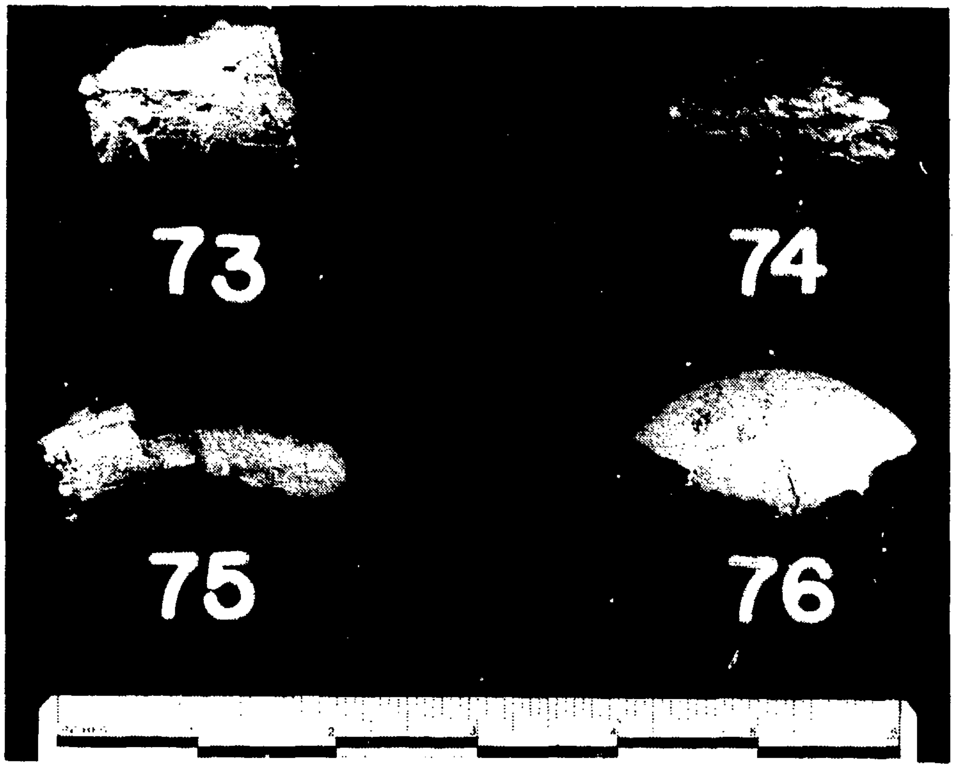

FRAGMENTS 69 THROUGH 72



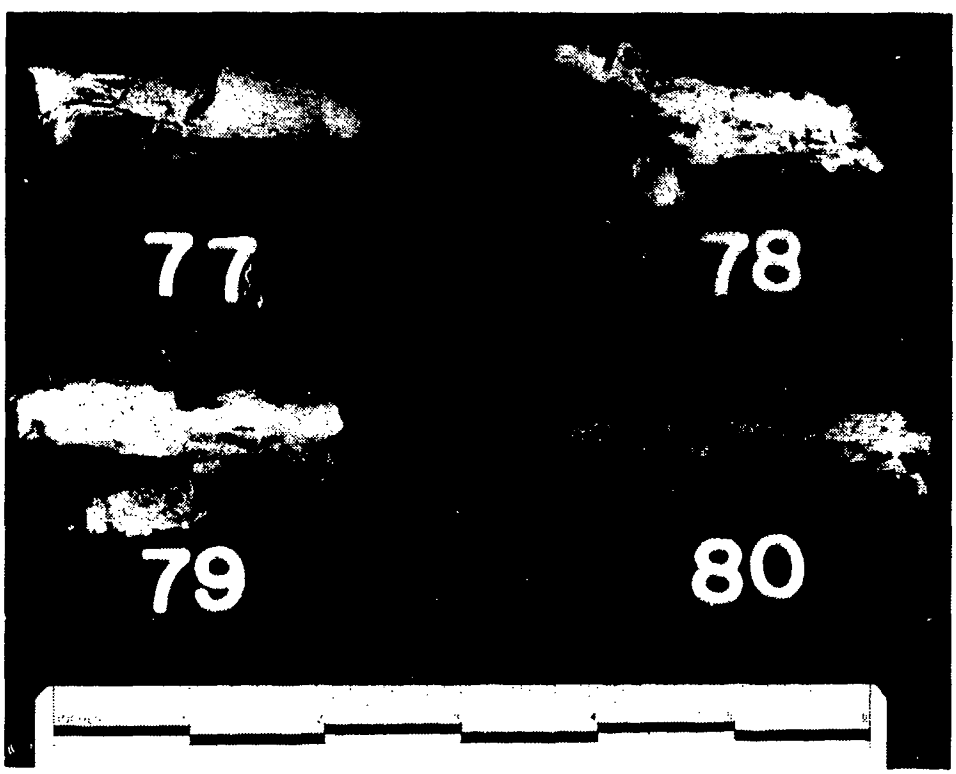

FRAGMENTS 57 THROUGH 60



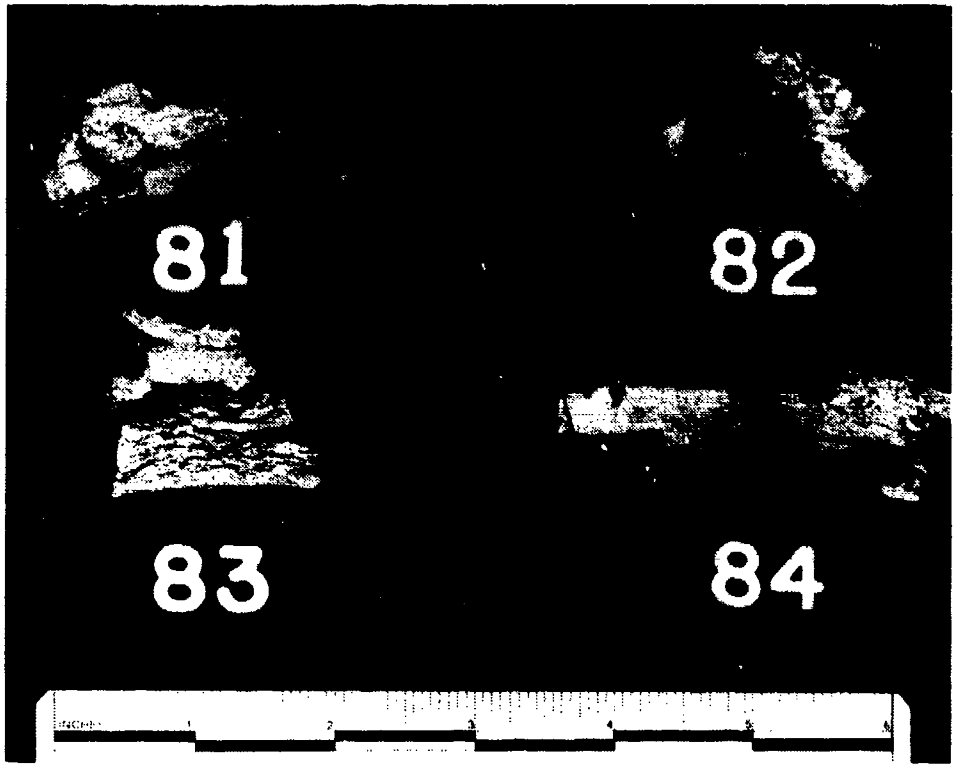

FRAGMENTS 61 THROUGH 64



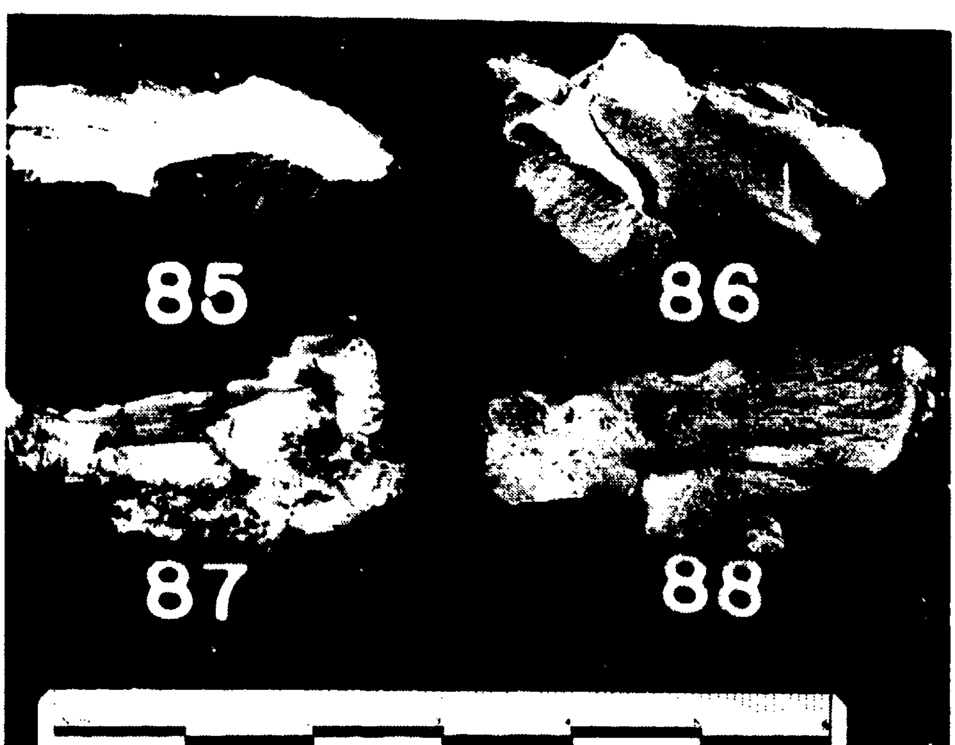

FRAGMENTS 73 THROUGH 76



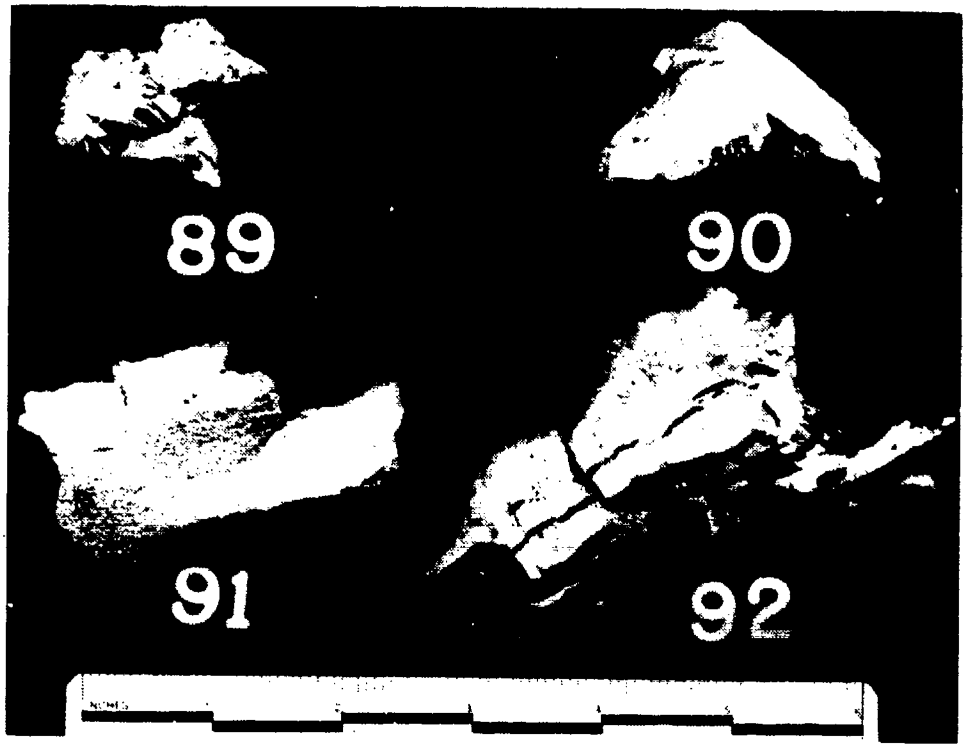

FRAGMENTS 77 THROUGH 80



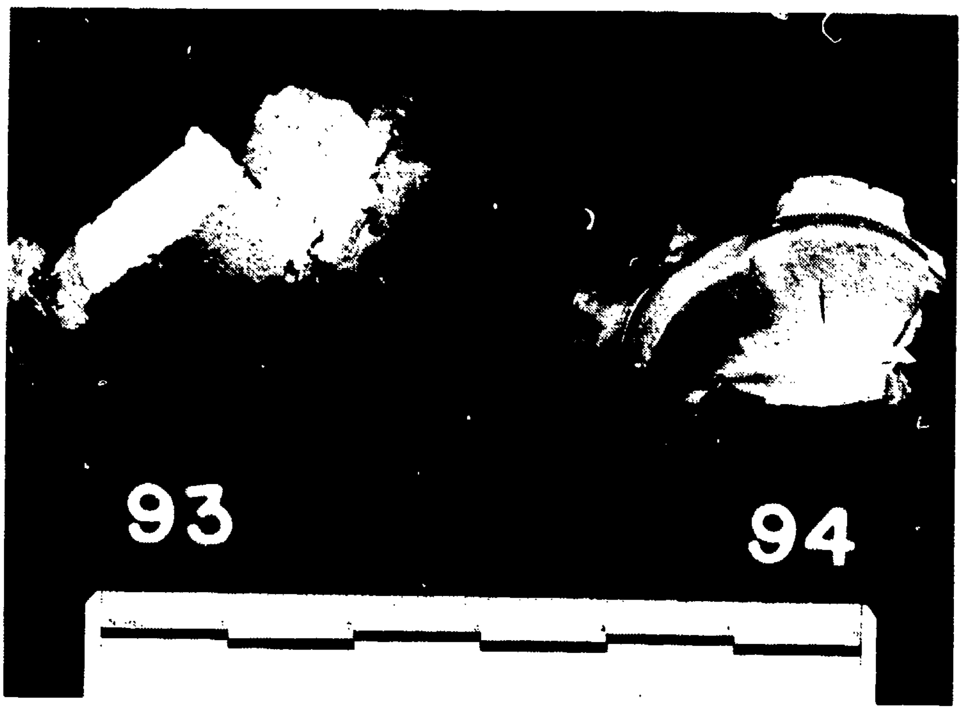

FRAGMENTS 81 THROUGH 84




FRAGMENTS 85 THROUGH 88




FRAGMENTS 89 THROUGH 92




FRAGMENTS 93 THROUGH 94

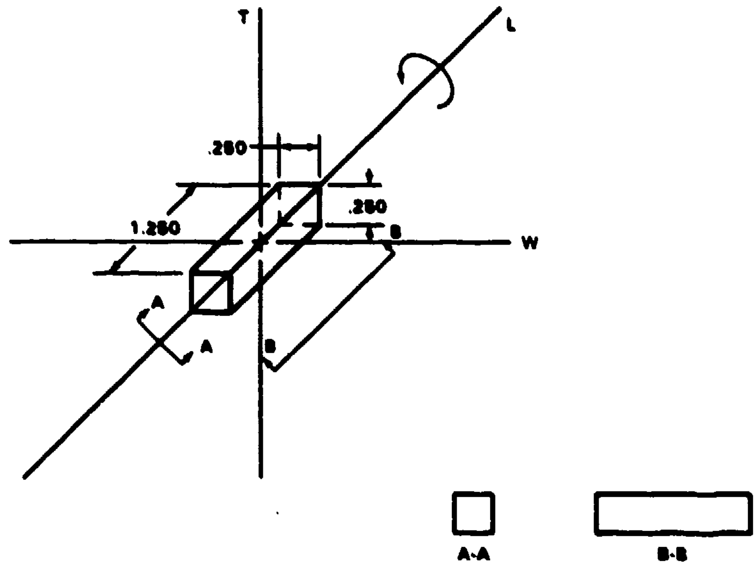

FRAGMENTS 95 THROUGH 96

# APPENDIX C

# VERTICAL WIND TUNNEL TEST RECORDS

This appendix contains the individual test records for the 96 fragments tested in the vertical wind tunnel. Each record contains three diagrams (views) of the fragment which are faithful representations of the fragment shape but not to scale. The dimensions of the three views can be inferred by reference to Table A-2 of Appendix A and the plan views in Appendix D.

Each record shows the axes about which fragment motion in the wind tunnel is referenced in the comments at the bottom of the test record. The calculated $C_D$ and the values of variables necessary to calculate it are also given. In all cases the area refers to the average presented area of the fragment.




DATE 3/28/85

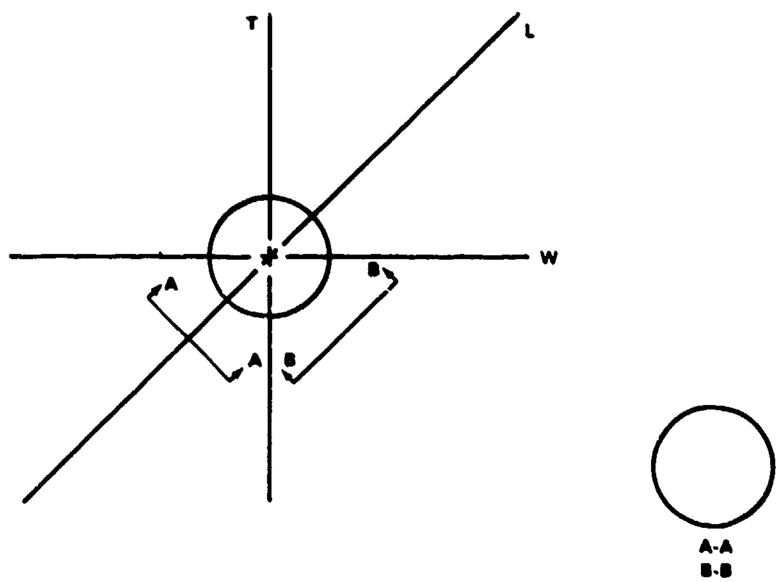
TEST NO. 210

RUN NO. 1

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 1 | .38218 | .00234 | 750.0 | 52 | .002378 | 93.8 | .9354766 |

COMMENTS: PARALLELEPIPED HAS REPLACED THE 1.625 SPHERE AS FRAGMENT # 1 ROTATES AROUND L AXIS AND IF DISTURBED WILL START TO CONE AROUND THE SAME AXIS

FIGURE C-1. TEST RECORD FOR FRAGMENT NO. 1




DATE 3/28/85

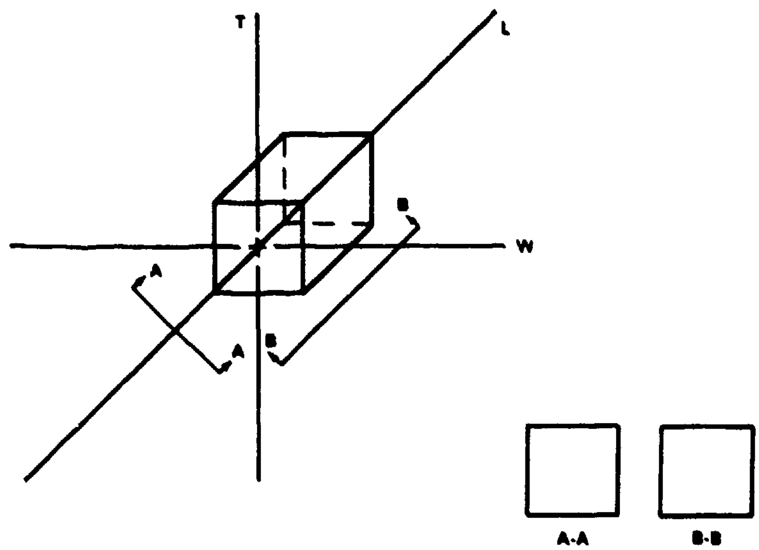
TEST NO. 210

RUN NO. 2

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 2 | .1472 | .00545 | 762.4 | 48 | .002436 | 228.9 | .42323 |

COMMENTS: SPHERE

FIGURE C-2. TEST RECORD FOR FRAGMENT NO. 2




DATE 3/28/85

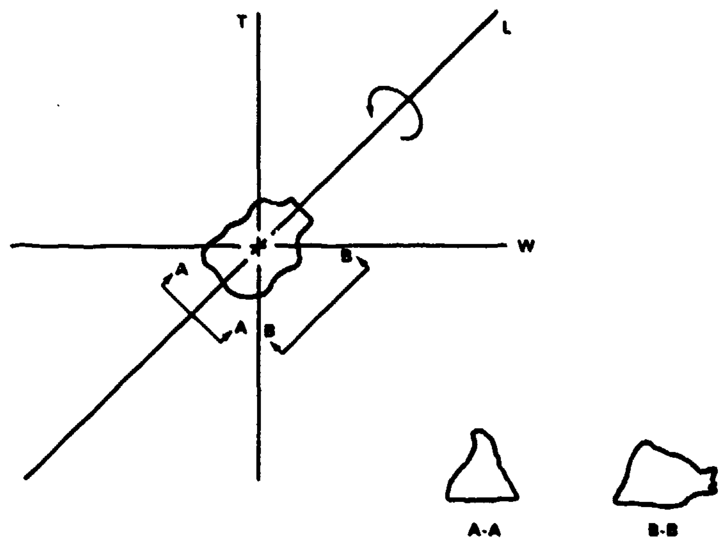
TEST NO. 210

RUN NO. 3

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 3 | .1193 | .00603 | 762.4 | 48 | .002436 | 159.8 | .63810 |

COMMENTS: CUBE (¼) WILL ROTATE AROUND ANY AXIS

FIGURE C-3. TEST RECORD FOR FRAGMENT NO. 3




DATE 3/28/85

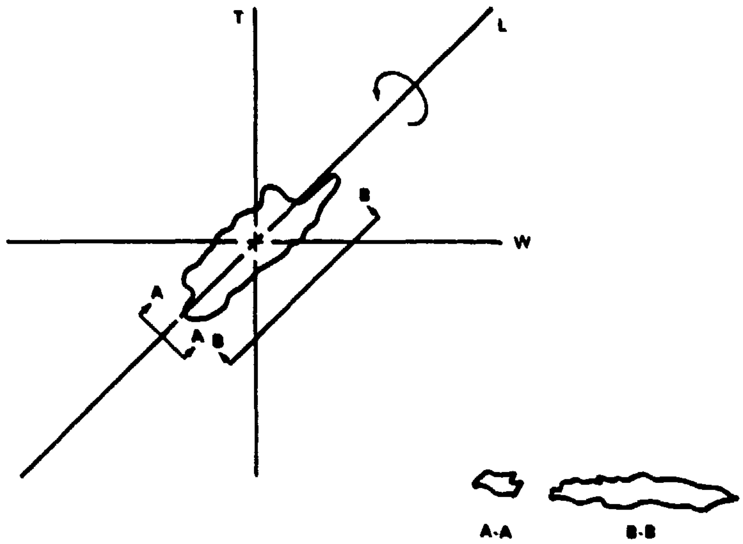
TEST NO. 210

RUN NO. 4

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 4 | .0158 | .002054 | 756.4 | 76 | .002291 | 85.8 | .91220 |

COMMENTS: TUMBLES IN ALL DIRECTIONS

FIGURE C-4. TEST RECORD FOR FRAGMENT NO. 4




DATE 3/28/85

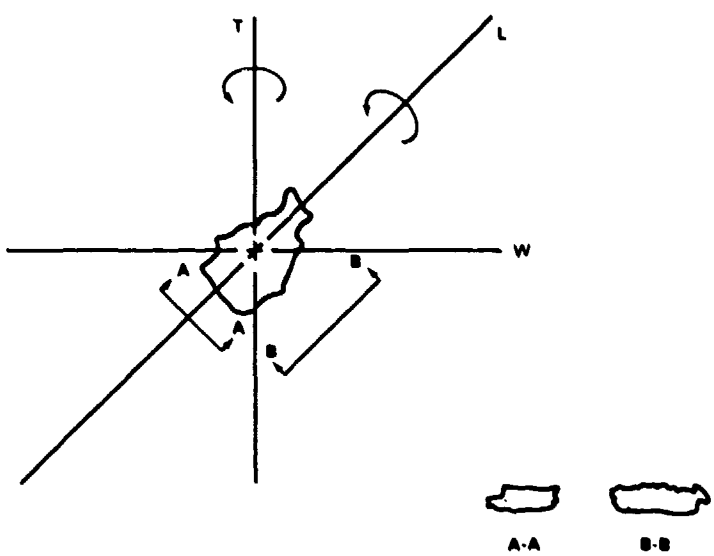
TEST NO. 210

RUN NO. 5

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 5 | .01604 | .00258 | 754.8 | 82 | .002261 | 68.1 | 1.18582 |

COMMENTS: ROTATES ALONG THE LONGITUDINAL AXIS AND WILL CONE ABOUT THE

FIGURE C-5. TEST RECORD FOR FRAGMENT NO. 5




DATE 3/28/85

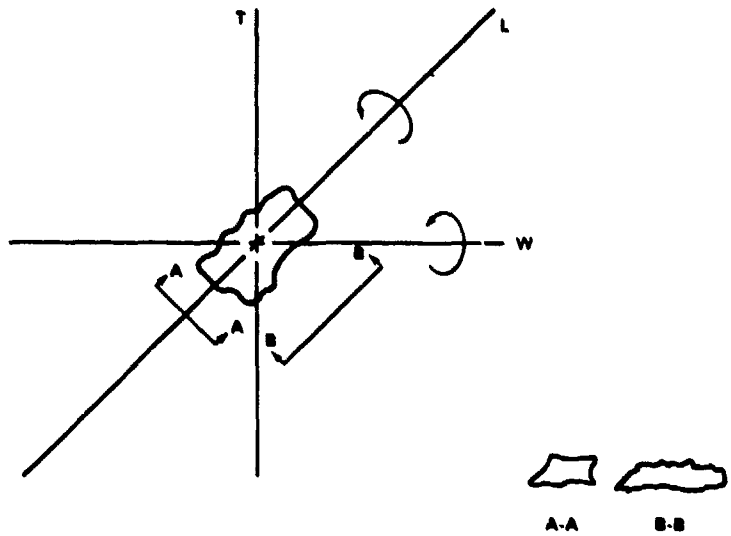
TEST NO. 210

RUN NO. 6

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 6 | .01617 | .00206 | 754.8 | 82 | .002261 | 81 | 1.05828 |

COMMENTS: ROTATES AROUND BOTH T AND L AXIS — WHEN DISTURBED, IT TUMBLES

FIGURE C-6. TEST RECORD FOR FRAGMENT NO. 6




DATE 3/28/84

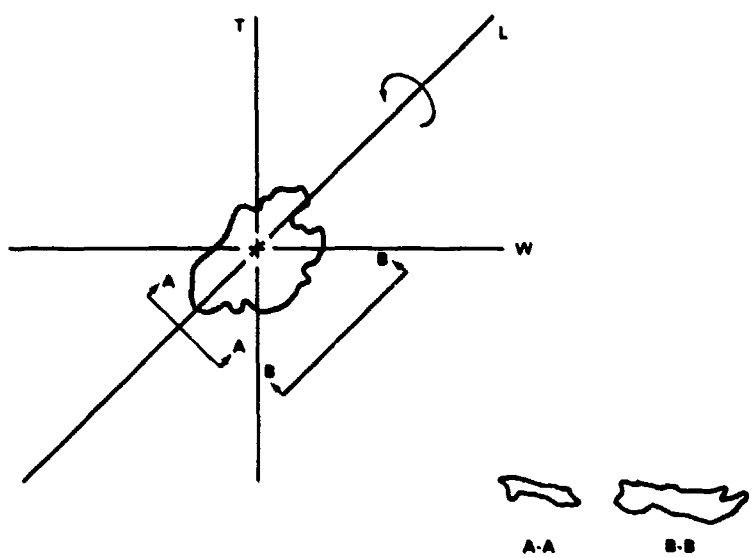
TEST NO. 210

RUN NO. 7

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 7 | .01646 | .002106 | 764.8 | 82 | .002261 | 81 | 1.06374 |

COMMENTS: WILL ROTATE ABOUT THE L AND W AXIS

FIGURE C-7. TEST RECORD FOR FRAGMENT NO. 7




DATE 3/29/85

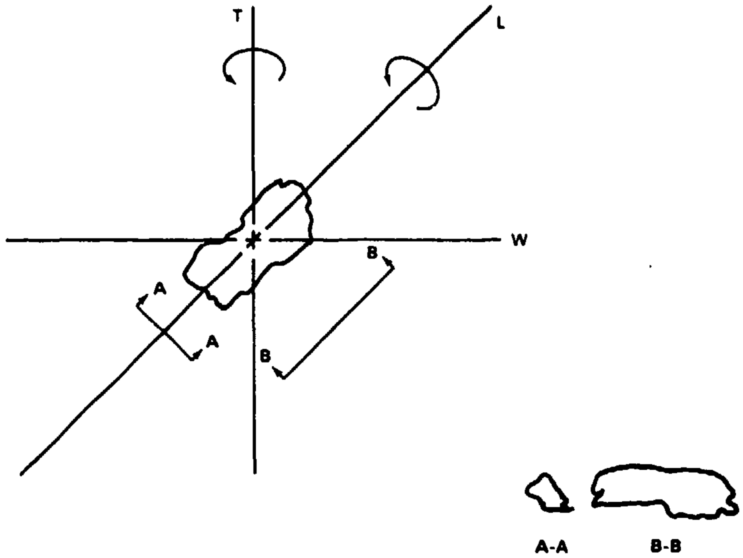
TEST NO. 210

RUN NO. 8

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 8 | .0171 | .002603 | 766.3 | 66 | .002331 | 64.9 | 1.33820 |

COMMENTS: ROTATES AROUND THE L AXIS

FIGURE C-8. TEST RECORD FOR FRAGMENT NO. 8




DATE 3/29/85

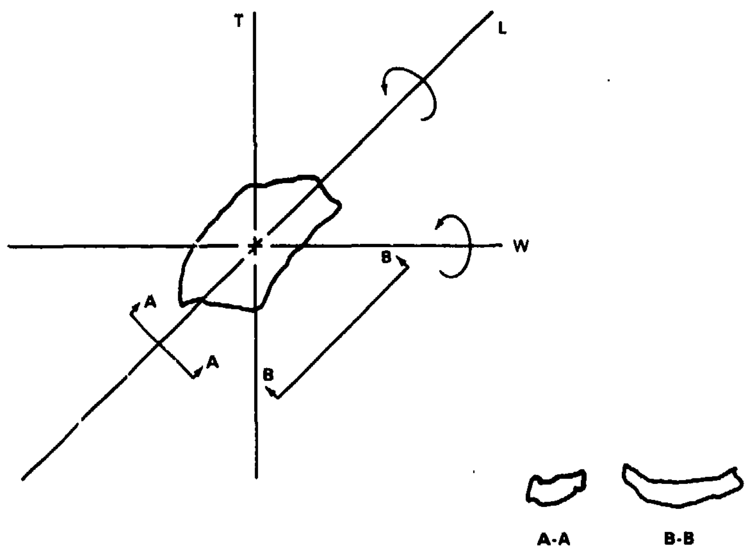
TEST NO. 210

RUN NO. 9

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 9 | .01736 | .002451 | 755.3 | 66 | .002331 | 81 | .92624 |

COMMENTS: ROTATES AROUND L AND T AND ALSO CONING AROUND THE L AXIS

FIGURE C-9. TEST RECORD FOR FRAGMENT NO. 9




DATE 3/29/85

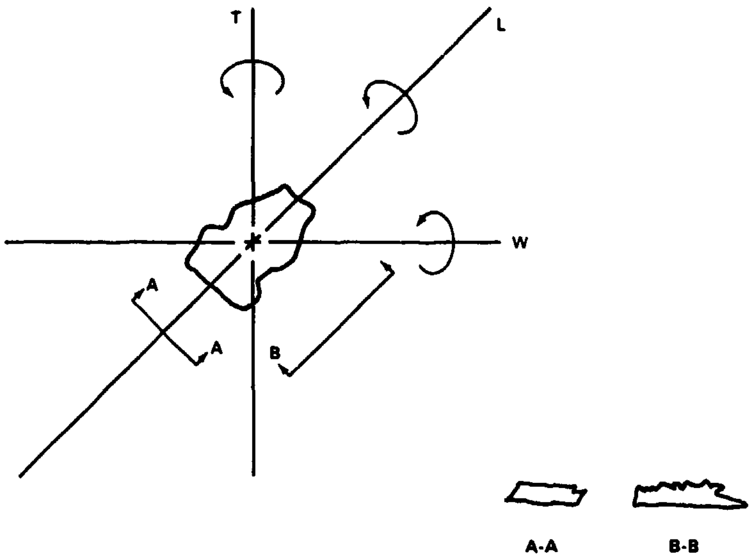
TEST NO. 210

RUN NO. 10

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 10 | .0174 | .003013 | 755.3 | 62 | .002349 | 71.3 | .96720 |

COMMENTS: ROTATES AROUND L AND W

FIGURE C-10. TEST RECORD FOR FRAGMENT NO. 10




DATE 3/29/85

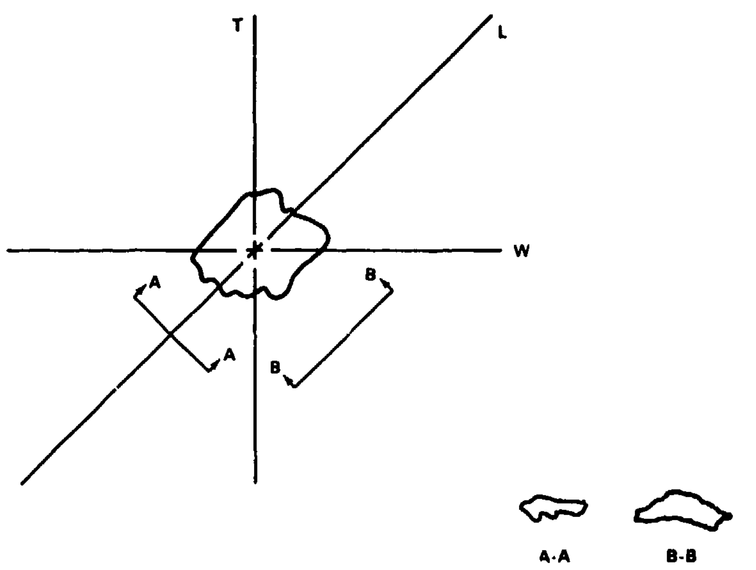
TEST NO. 210

RUN NO. 11

| FRAGMENT NUMBER | WEIGHT (lb) | AREA (ft²) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/ft³) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 11 | .08137 | .0023307 | 755.3 | 61 | .002353 | 93.8 | .76142 |

COMMENTS: AT LIFT OFF IT WAS SPINNING FLAT AROUND T — THEN WOULD ROTATE AROUND ALL 3 AXES

FIGURE C-11. TEST RECORD FOR FRAGMENT NO. 11




DATE 3/29/85

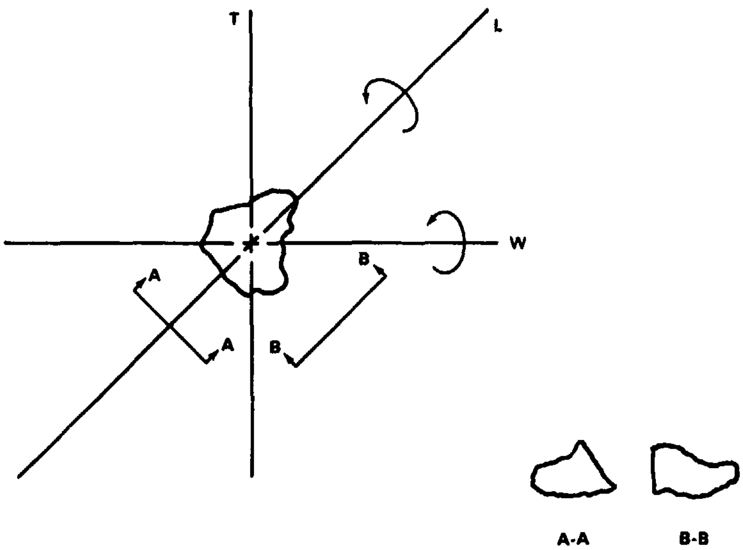
TEST NO. 210

RUN NO. 12

| FRAGMENT NUMBER | WEIGHT (lb) | AREA (ft²) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/ft³) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 12 | .0184 | .0023224 | 755.3 | 61 | .002353 | 87.4 | .88159 |

COMMENTS: LIFT'S OFF FLOATING FLAT, THEN ROTATES AROUND ALL 3 AXES

FIGURE C-12. TEST RECORD FOR FRAGMENT NO. 12




DATE 3/29/85

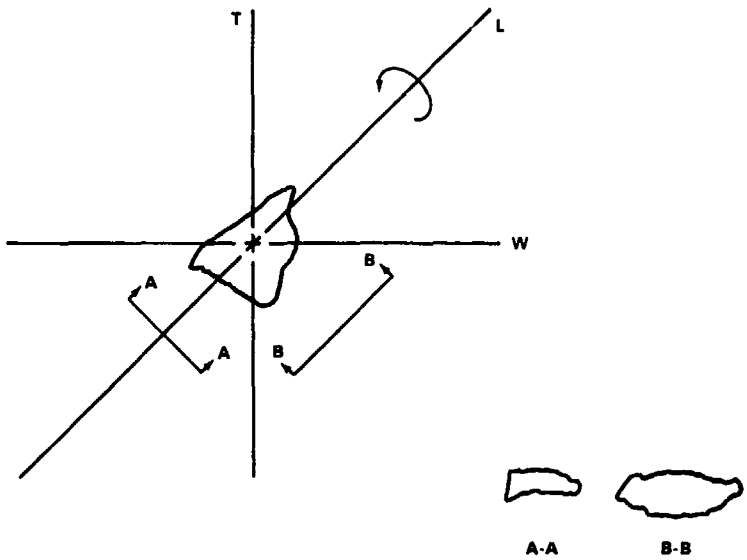
TEST NO. 210

RUN NO. 13

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 13 | .01868 | .00196 | 755.3 | 61 | .002353 | 98.7 | .83156 |

COMMENTS: ROTATES AROUND L AND W — GOES FLAT AND THEN TUMBLES

FIGURE C-13. TEST RECORD FOR FRAGMENT NO. 13




DATE 3/29/85

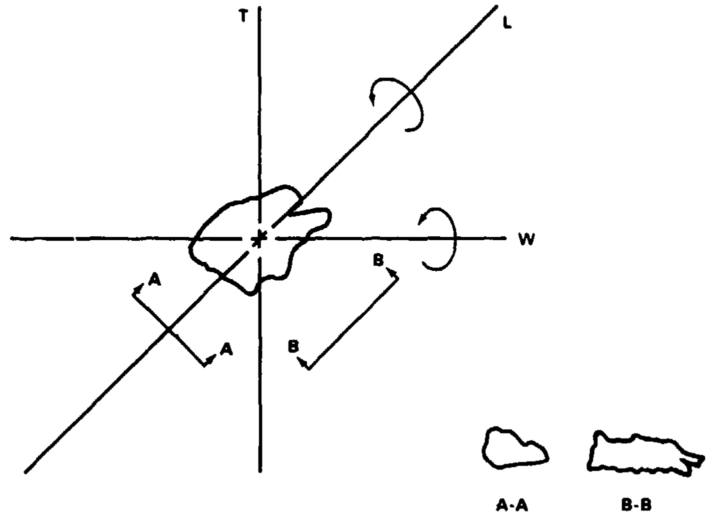
TEST NO. 210

RUN NO. 14

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 14 | .01898 | .00236 | 755.4 | 61 | .002354 | 84.2 | .96379 |

COMMENTS: ROTATES AROUND L TO START AND THEN TUMBLES

FIGURE C-14. TEST RECORD FOR FRAGMENT NO. 14




DATE 3/29/85

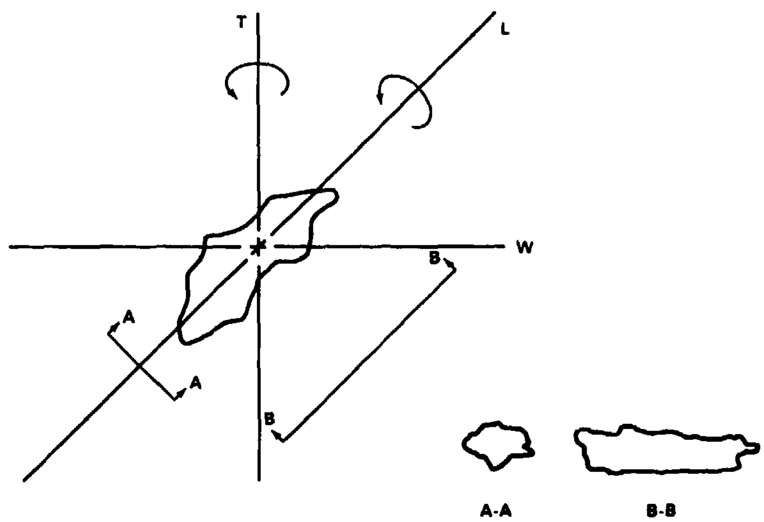
TEST NO. 210

RUN NO. 15

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 15 | .01936 | .002373 | 755.4 | 61 | .002354 | 84.2 | .97770 |

COMMENTS: ROTATES IN L AXIS THEN W

FIGURE C-15. TEST RECORD FOR FRAGMENT NO. 15




DATE 3/29/85

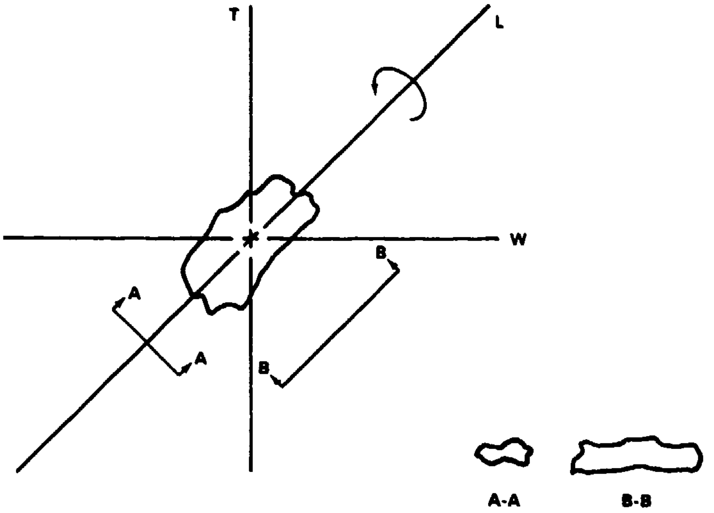
TEST NO. 210

RUN NO. 16

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 16 | .02144 | .002918 | 755.4 | 61 | .002354 | 81 | .95146 |

COMMENTS: ROTATES AROUND L AND T

FIGURE C-16. TEST RECORD FOR FRAGMENT NO. 16




DATE 3/29/85

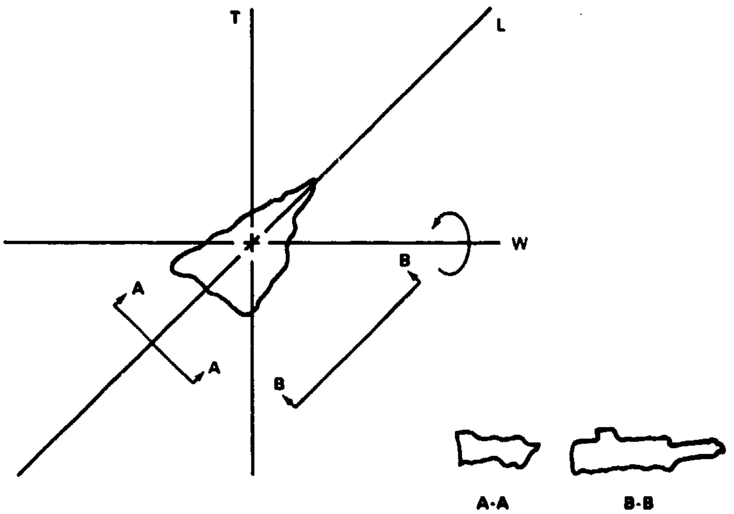
TEST NO. 210

RUN NO. 17

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 17 | .02221 | .002649 | 755.4 | 64 | .002340 | 87.4 | .93812 |

COMMENTS: STARTS OFF AROUND THE L AXIS THEN TUMBLES

FIGURE C-17. TEST RECORD FOR FRAGMENT NO. 17




DATE 3/29/85

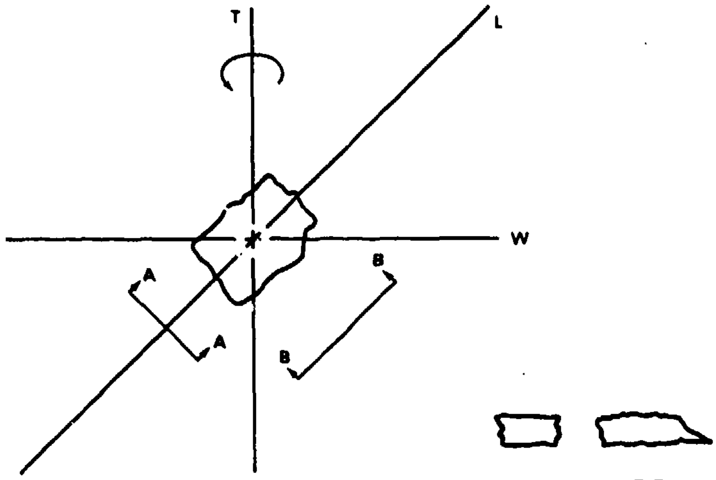
TEST NO. 210

RUN NO. 18

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 18 | .02266 | .002638 | 755.4 | 64 | .002340 | 93.8 | .83444 |

COMMENTS: STARTS OF ROTATING AROUND W AND THEN TUMBLES

FIGURE C-18. TEST RECORD FOR FRAGMENT NO. 18




DATE 3/29/85

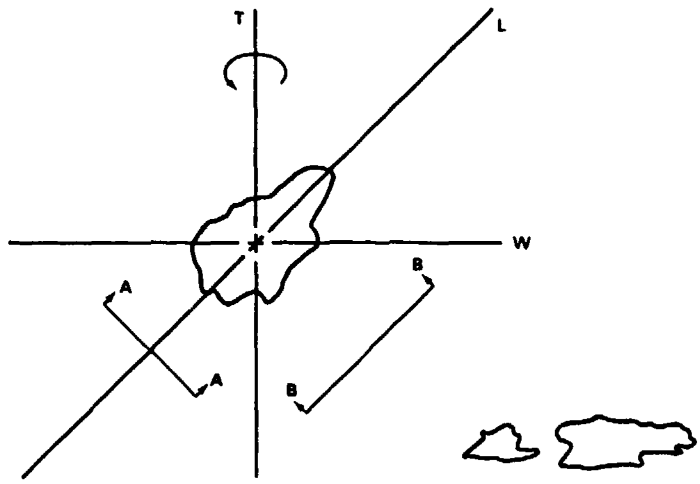
TEST NO. 210

RUN NO. 19

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 19 | .02301 | .00248 | 755 | 66 | .002330 | 81 | 1.21386 |

COMMENTS: FLAT SPIN AROUND T

FIGURE C-19. TEST RECORD FOR FRAGMENT NO. 19




DATE 3/29/85

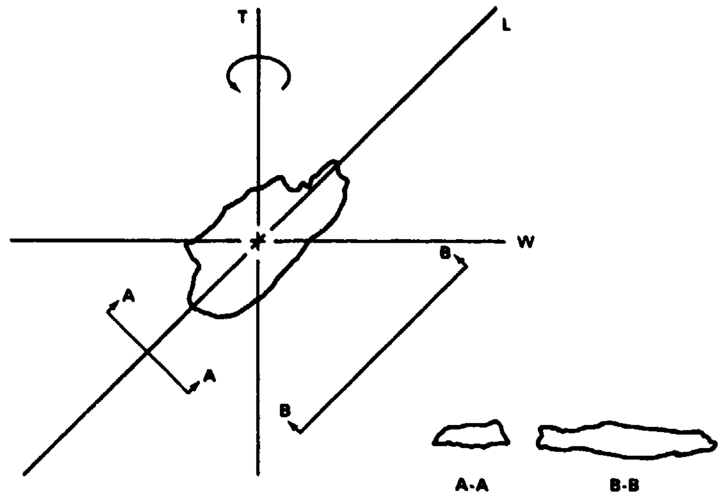
TEST NO. 210

RUN NO. 20

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 20 | .02546 | .003043 | 755 | 67 | .002325 | 74.6 | 1.29326 |

COMMENTS: FLAT ROTATION

FIGURE C-20. TEST RECORD FOR FRAGMENT NO. 20




DATE 3/29/85

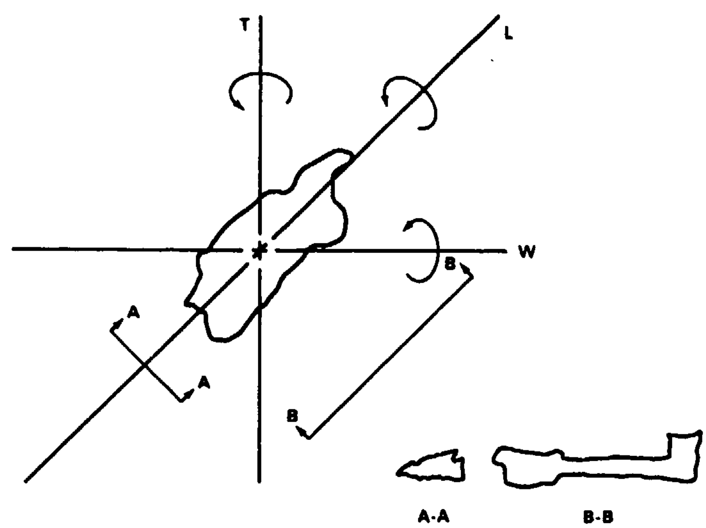
TEST NO. 210

RUN NO. 21

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 21 | .02693 | .00331 | 755 | 67 | .002325 | 71.3 | 1.37669 |

COMMENTS: FLAT SPIN AND TUMBLE

FIGURE C-21. TEST RECORD FOR FRAGMENT NO. 21




DATE 3/29/85

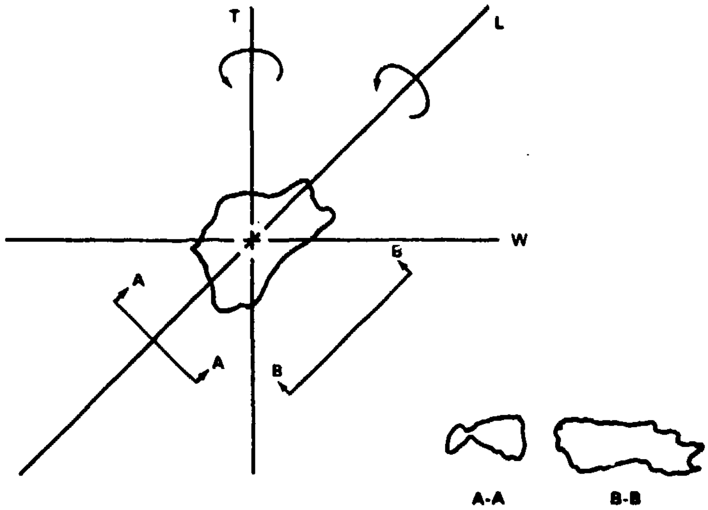
TEST NO. 210

RUN NO. 22

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 22 | .0291 | .00380 | 755 | 67 | .002325 | 74.6 | 1.18369 |

COMMENTS: STARTS ROTATING AROUND L THEN T AND W

FIGURE C-22. TEST RECORD FOR FRAGMENT NO. 22




DATE 3/29/85

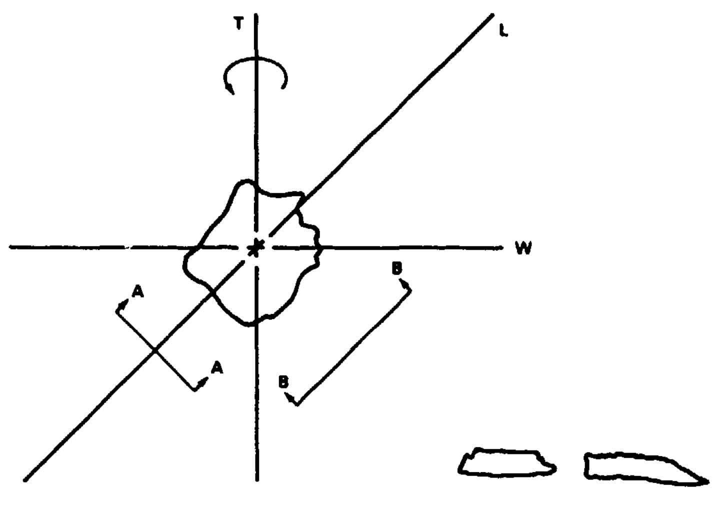
TEST NO. 210

RUN NO. 23

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 23 | .03054 | .00315 | 755 | 67 | .002325 | 90.6 | 1.01604 |

COMMENTS: ROTATES AROUND T THEN L

FIGURE C-23. TEST RECORD FOR FRAGMENT NO. 23




DATE 3/29/85

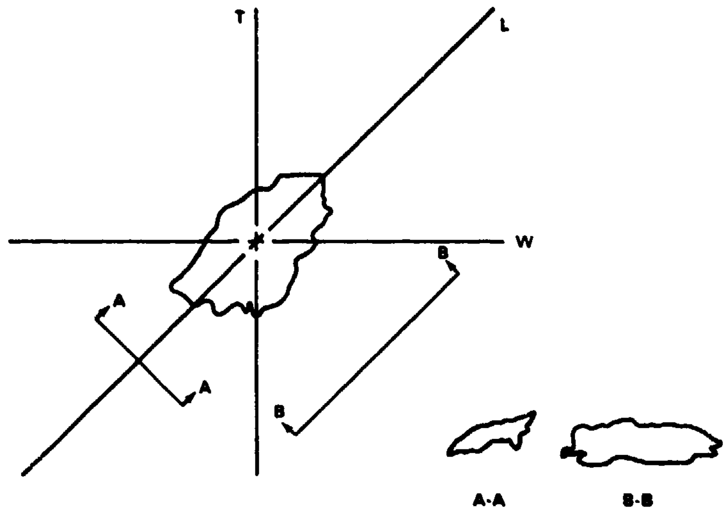
TEST NO. 210

RUN NO. 24

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 24 | .03066 | .00320 | 755 | 68 | .002321 | 74.6 | 1.48354 |

COMMENTS: ROTATES AROUND T TO START IN A FLAT SPIN

FIGURE C-24. TEST RECORD FOR FRAGMENT NO. 24




DATE 3/29/85

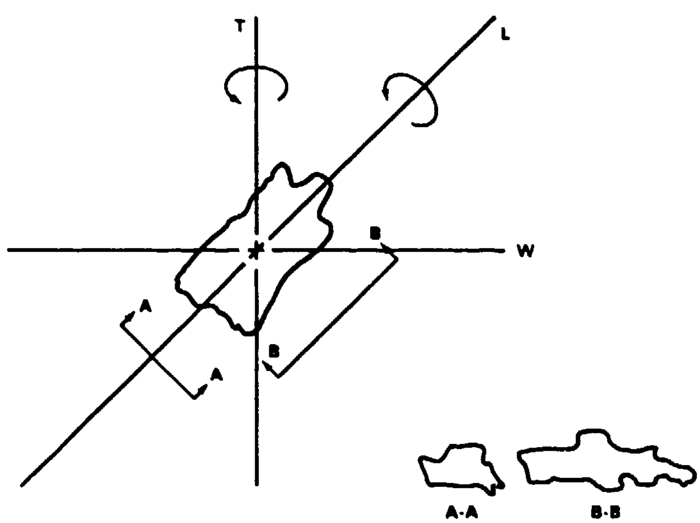
TEST NO. 210

RUN NO. 25

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 25 | .03377 | .0036779 | 755.2 | 66 | .002331 | 77.8 | 1.30155 |

COMMENTS: FLAT ROTATION AROUND T

FIGURE C-25. TEST RECORD FOR FRAGMENT NO. 25




DATE 3/29/85

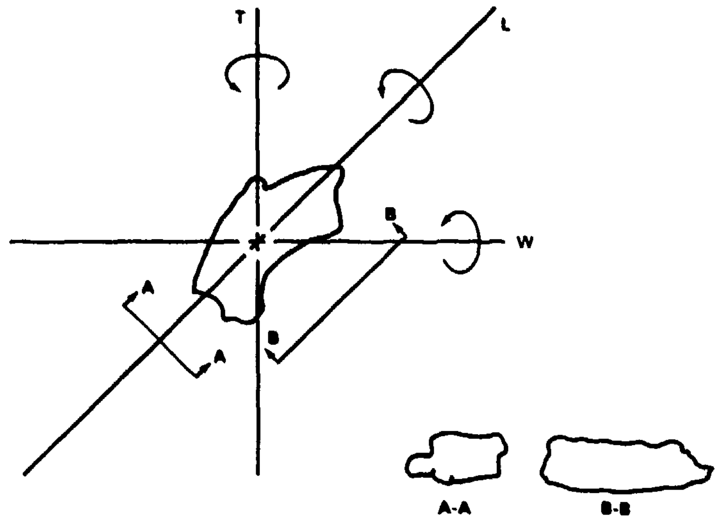
TEST NO. 210

RUN NO. 26

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 26 | .0342 | .00376 | 755.1 | 66 | .002330 | 81 | 1.18999 |

COMMENTS: FLAT SPIN AROUND T AND ALSO ROTATES AROUND THE L AXIS

FIGURE C-26. TEST RECORD FOR FRAGMENT NO. 26




DATE 3/29/85

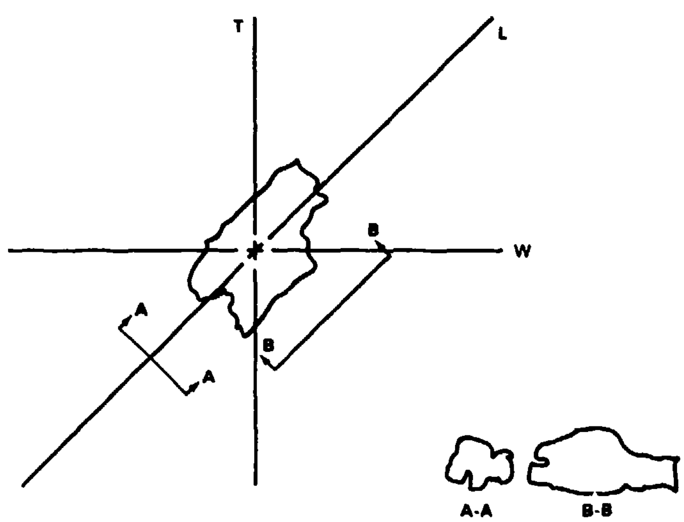
TEST NO. 210

RUN NO. 27

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 27 | .03451 | .00377 | 755.1 | 66 | .002330 | 93.8 | .89304 |

COMMENTS: ROTATES AROUND ALL 3 AXES

FIGURE C-27. TEST RECORD FOR FRAGMENT NO. 27




DATE 3/29/85

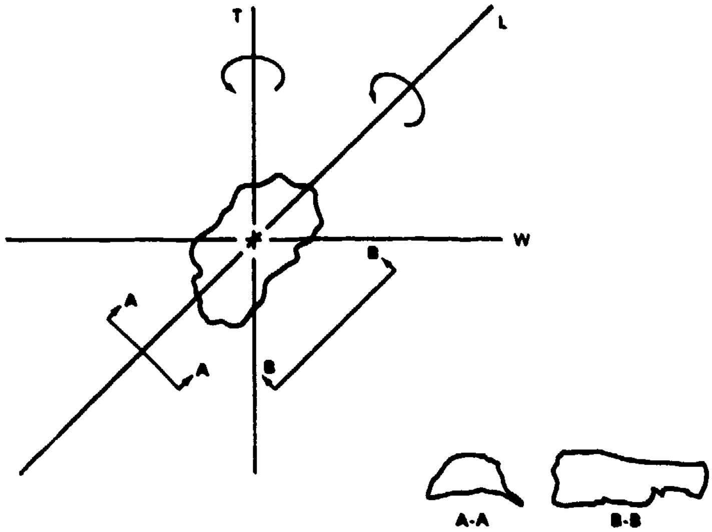
TEST NO. 210

RUN NO. 28

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 28 | .03497 | .0037161 | 755.1 | 66 | .002330 | 77.8 | 1.33452 |

COMMENTS: FLAT SPINNING AROUND T

FIGURE C-28. TEST RECORD FOR FRAGMENT NO. 28




DATE 3/29/85

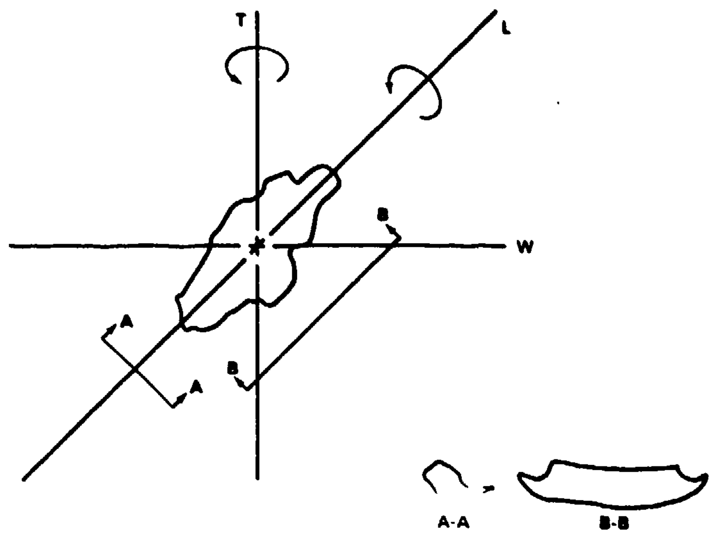
TEST NO. 210

RUN NO. 29

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 29 | .03553 | .00362 | 755.5 | 67 | .002327 | 93.8 | .95877 |

COMMENTS: ROTATES AROUND T AND L

FIGURE C-29. TEST RECORD FOR FRAGMENT NO. 29




DATE 3/29/85

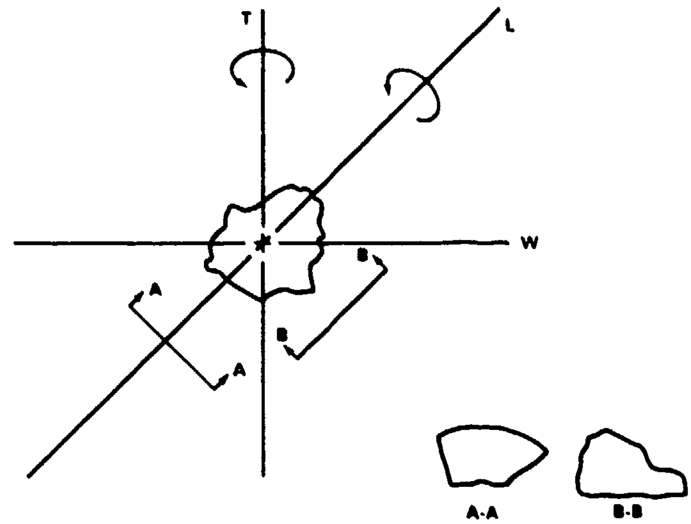
TEST NO. 210

RUN NO. 30

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 30 | .03644 | .00357 | 755.5 | 67 | .002327 | 84.2 | 1.23743 |

COMMENTS: ROTATES AROUND T AND L

FIGURE C-30. TEST RECORD FOR FRAGMENT NO. 30




DATE 3/29/86

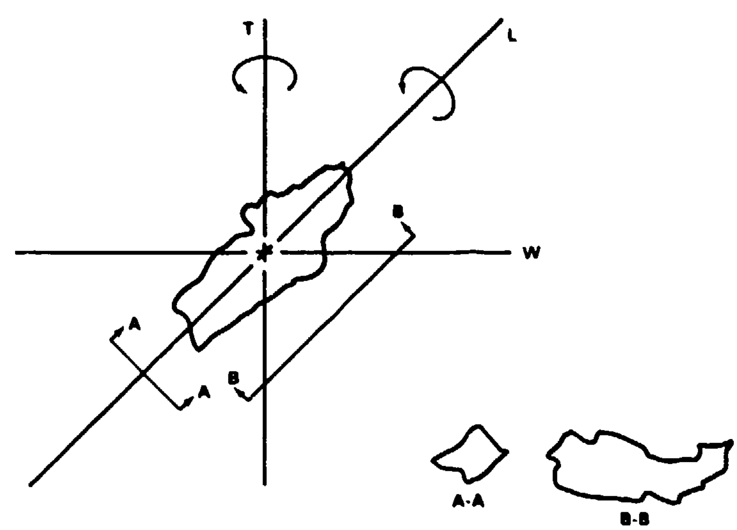
TEST NO. 210

RUN NO. 31

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 31 | .03841 | .00322 | 756 | 68 | .002324 | 103.5 | .95830 |

COMMENTS: ROTATES AROUND T AND L

FIGURE C-31. TEST RECORD FOR FRAGMENT NO. 31




DATE 3/29/86

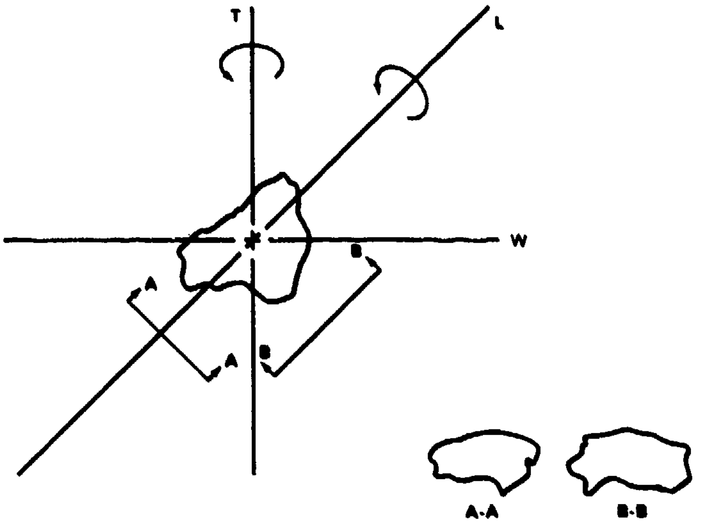
TEST NO. 210

RUN NO. 32

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 32 | .03963 | .00432 | 756 | 68 | .002324 | 93.8 | .89728 |

COMMENTS: ROTATES AROUND T AND L

FIGURE C-32. TEST RECORD FOR FRAGMENT NO. 32




DATE 3/29/85

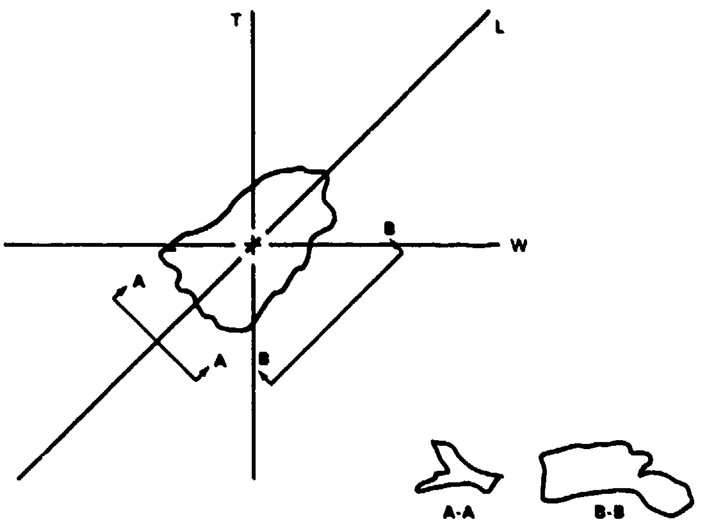
TEST NO. 210

RUN NO. 33

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 33 | .04003 | .00333 | 755.5 | 69 | .002318 | 109.9 | .85874 |

COMMENTS: ROTATES AROUND T AND L

FIGURE C-33. TEST RECORD FOR FRAGMENT NO. 33




DATE 3/29/85

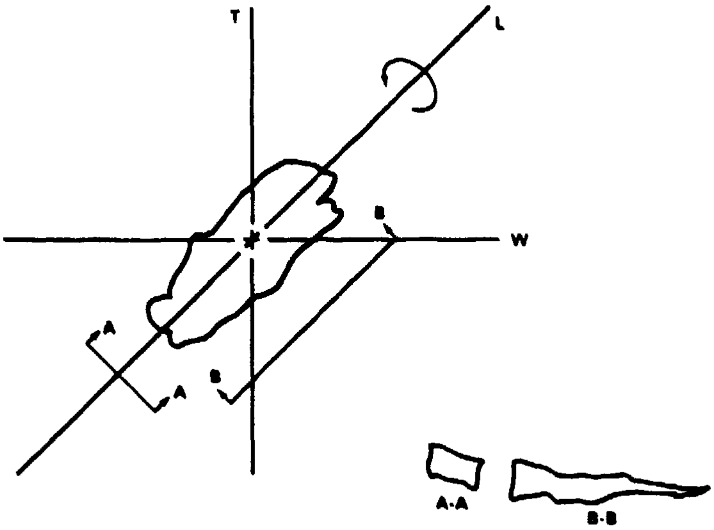
TEST NO. 210

RUN NO. 34

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 34 | .04159 | .00423 | 755.5 | 69 | .002318 | 81 | 1.29299 |

COMMENTS: ROTATES AROUND ALL 3 AXES

FIGURE C-34. TEST RECORD FOR FRAGMENT NO. 34




DATE 3/29/85

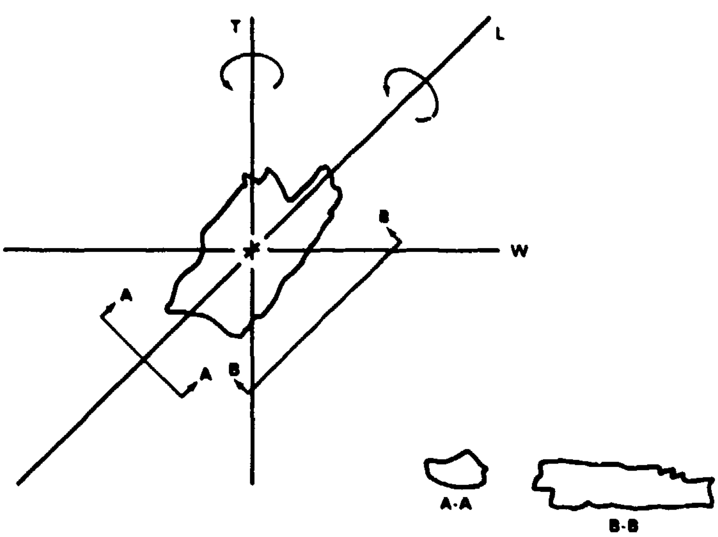
TEST NO. 210

RUN NO. 35

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 35 | .04326 | .00471 | 755.5 | 69 | .002318 | 100.3 | .78774 |

COMMENTS: STARTED OFF ROTATING AROUND L AND THEN WENT INTO ALL 3

FIGURE C-35. TEST RECORD FOR FRAGMENT NO. 35




DATE 3/29/85

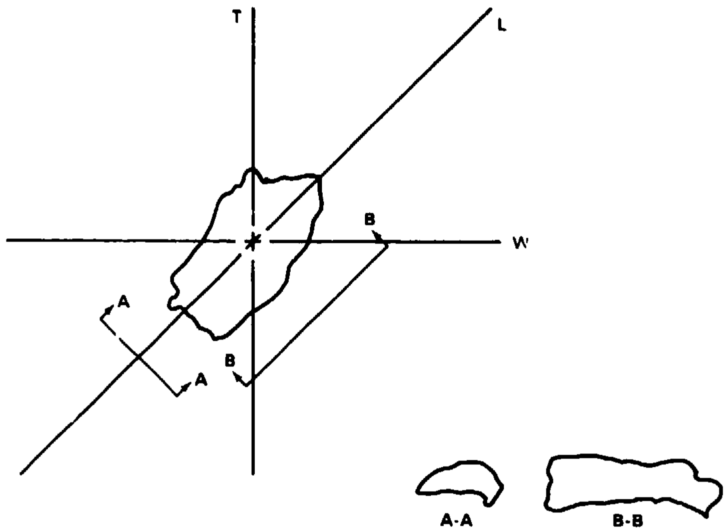
TEST NO. 210

RUN NO. 36

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 36 | .04354 | .00427 | 755.5 | 71 | .002309 | 87.4 | 1.15517 |

COMMENTS: ROTATES AROUND T AND L

FIGURE C-36. TEST RECORD FOR FRAGMENT NO. 36




DATE 3/29/85

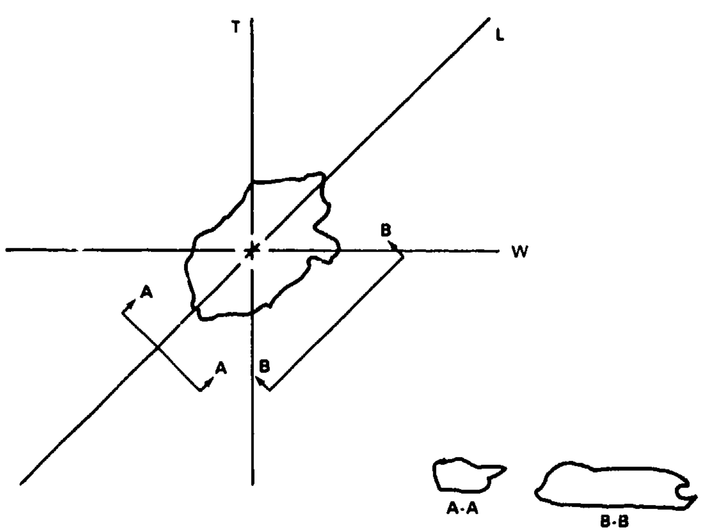
TEST NO. 210

RUN NO. 37

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 37 | .0442 | .00422 | 755.5 | 71 | .002309 | 97.1 | .96223 |

COMMENTS: FLAT SPIN AND AROUND L

FIGURE C-37. TEST RECORD FOR FRAGMENT NO. 37




DATE 3/29/85

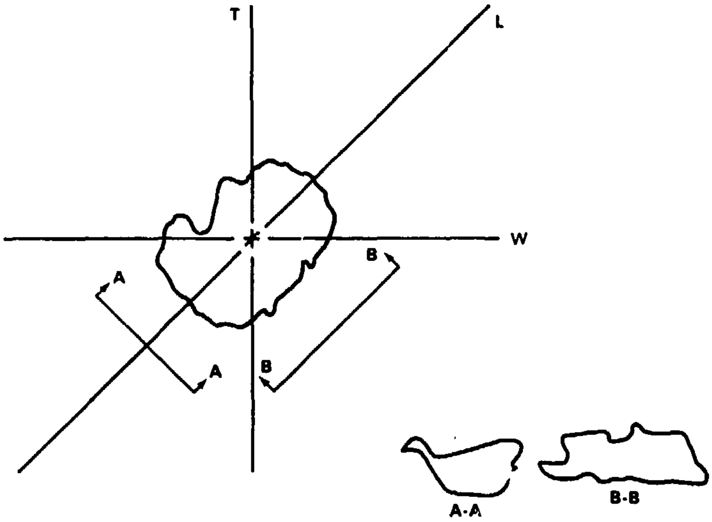
TEST NO. 210

RUN NO. 38

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 38 | .04473 | .00381 | 755.5 | 71 | .002309 | 101.9 | .97934 |

COMMENTS: FLAT SPIN AND ROTATES AROUND L

FIGURE C-38. TEST RECORD FOR FRAGMENT NO. 38




DATE 3/29/85

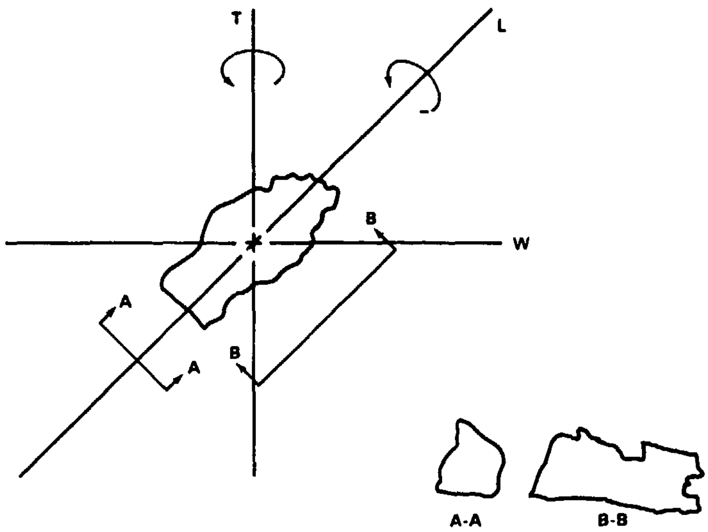
TEST NO. 210

RUN NO. 39

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 39 | .04627 | .00495 | 755 | 72 | .002304 | 97.1 | .86060 |

COMMENTS: ROTATES AROUND ALL AXES

FIGURE C-39. TEST RECORD FOR FRAGMENT NO. 39




DATE 3/29/85

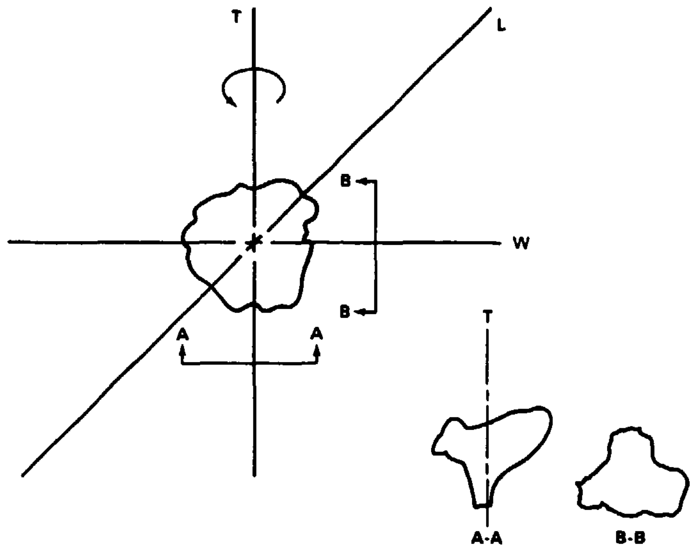
TEST NO. 210

RUN NO. 40

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 40 | .04653 | .00434 | 755 | 72 | .002304 | 106.7 | .81745 |

COMMENTS: ROTATES AROUND T AND L AND THEN CONING

FIGURE C-40. TEST RECORD FOR FRAGMENT NO. 40




DATE 3/29/85

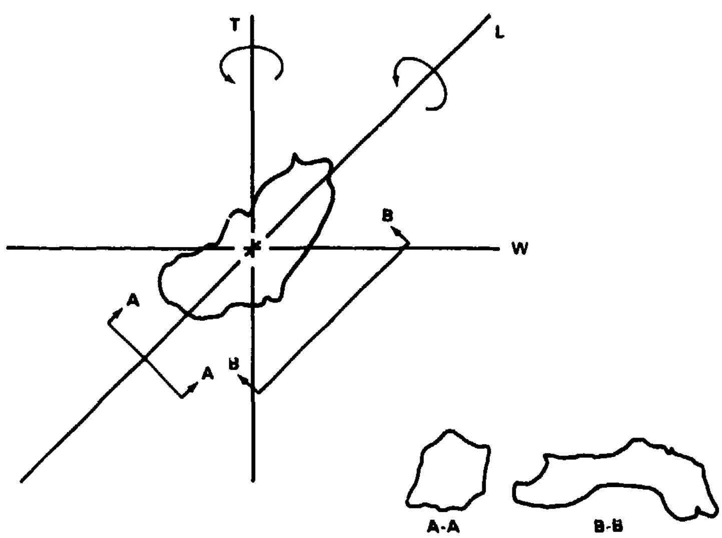
TEST NO. 210

RUN NO. 41

| FRAGMENT NUMBER | WEIGHT (lb) | AREA (ft$^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/ft$^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 41 | .0476 | .00401 | 755 | 72 | .002304 | 116.4 | .76050 |

COMMENTS: ROTATES AROUND T, SPINS LIKE A TOP EITHER AS SHOWN OR INVERTED

FIGURE C-41. TEST RECORD FOR FRAGMENT NO. 41




DATE 3/29/85

TEST NO. 210

RUN NO. 42

| FRAGMENT NUMBER | WEIGHT (lb) | AREA (ft$^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/ft$^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 42 | .04797 | .00449 | 755 | 72.5 | .002301 | 97.1 | .96491 |

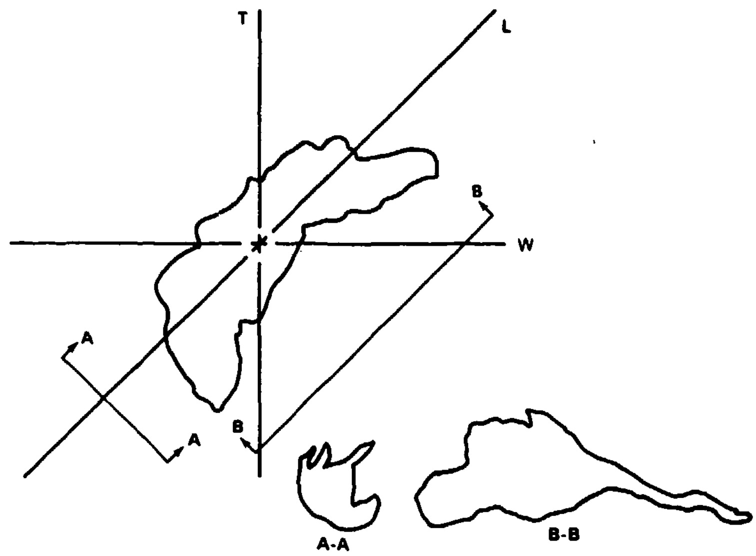
COMMENTS: ROTATES AROUND T AND L AND CONING

FIGURE C-42. TEST RECORD FOR FRAGMENT NO. 42

DATE 3/29/85

TEST NO. 210

RUN NO. 43




| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 43 | .0504 | .00705 | 755 | 74 | .002295 | 81 | .94955 |

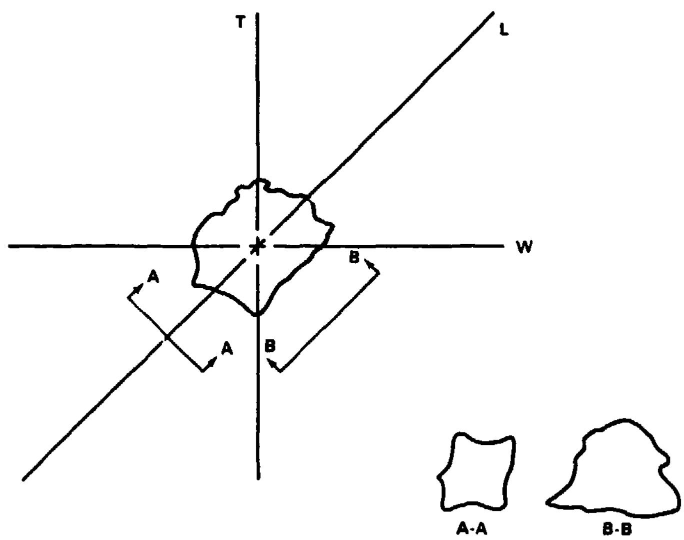
COMMENTS: ROTATES AROUND ALL 3 AXES - CHANGES FROM ONE TO ANOTHER WHEN IT CONTACTS THE

FIGURE C-43. TEST RECORD FOR FRAGMENT NO. 43

DATE 3/29/85

TEST NO. 210

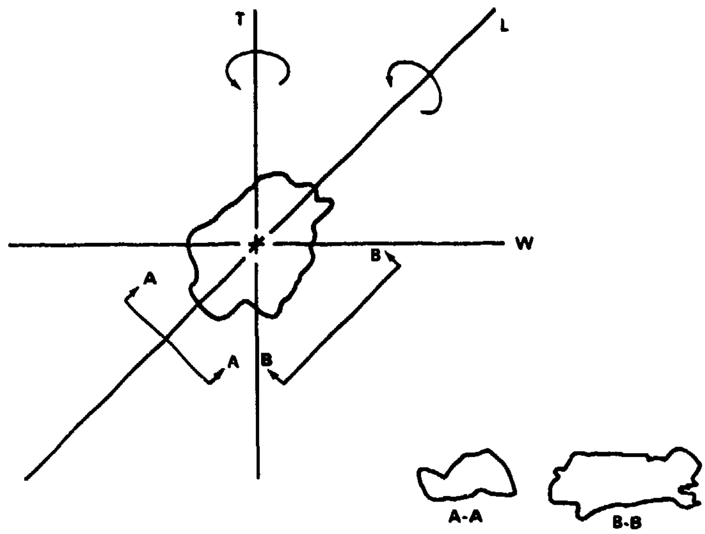
RUN NO. 44




| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 44 | .05057 | .00383 | 755 | 74 | .002295 | 126 | .72477 |

COMMENTS: ACTS LIKE FRAGMENT NO. 3 (CUBE) ROTATES AROUND ALL 3

FIGURE C-44. TEST RECORD FOR FRAGMENT NO. 44




DATE 3/29/85

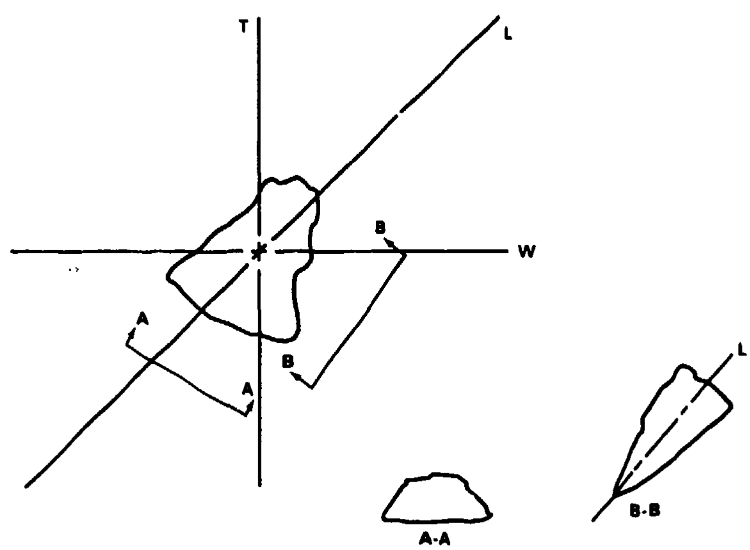
TEST NO. 210

RUN NO. 45

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 45 | .0507 | .00409 | 755 | 74 | .002295 | 116.4 | .79731 |

COMMENTS: ROTATES AROUND T AND L

FIGURE C-45. TEST RECORD FOR FRAGMENT NO. 45




DATE 3/29/85

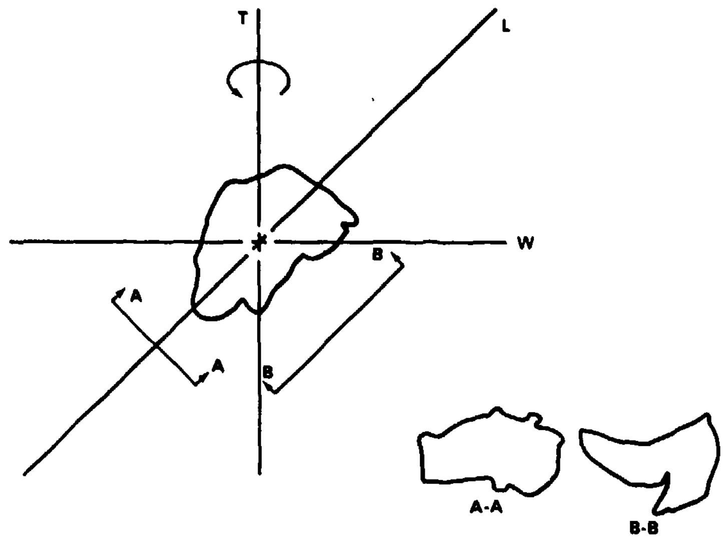
TEST NO. 210

RUN NO. 46

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 46 | .05113 | .00443 | 755 | 74 | .002295 | 109.9 | .83277 |

COMMENTS: ROTATES AROUND L

FIGURE C-46. TEST RECORD FOR FRAGMENT NO. 46




DATE 3/29/85

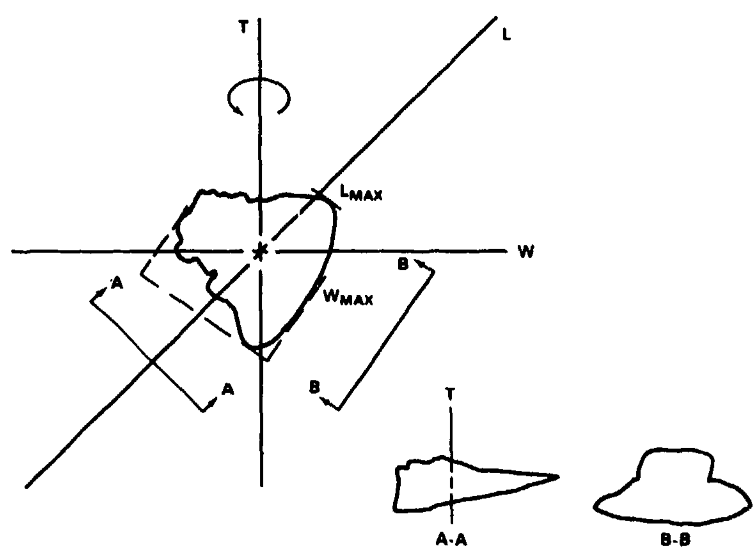
TEST NO. 210

RUN NO. 47

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 47 | .05131 | .00439 | 755 | 74 | .002295 | 108.3 | .86842 |

COMMENTS: FLAT SPIN AROUND T, THEN TUMBLES

FIGURE C-47. TEST RECORD FOR FRAGMENT NO. 47




DATE 3/29/85

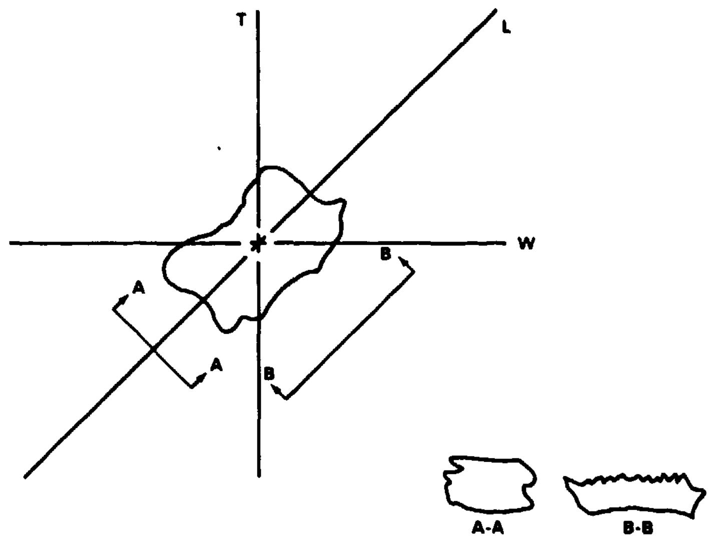
TEST NO. 210

RUN NO. 48

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 48 | .05146 | .00471 | 755.2 | 74 | .002296 | 95.5 | 1.04352 |

COMMENTS: ROTATES AROUND T

FIGURE C-48. TEST RECORD FOR FRAGMENT NO. 48




DATE 3/29/85

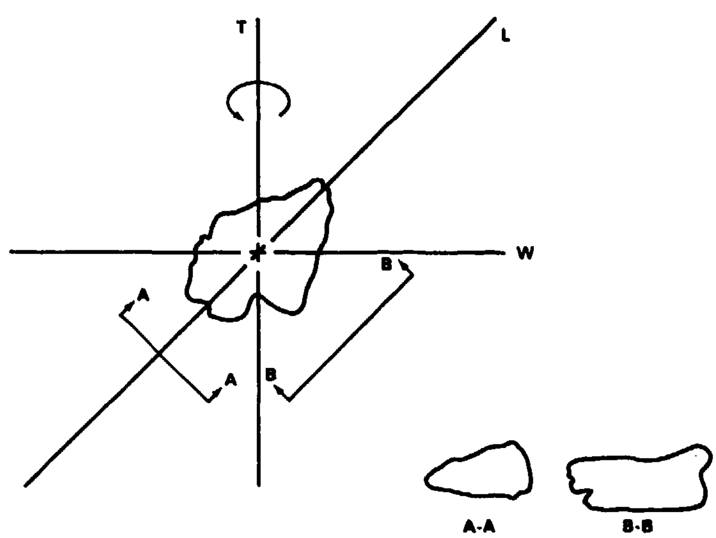
TEST NO. 210

RUN NO. 49

| FRAGMENT NUMBER | WEIGHT (lb) | AREA (ft²) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/ft³) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 49 | .0529 | .00442 | 755.2 | 74 | .002296 | 95.5 | 1.14310 |

COMMENTS: ROLLS, TUMBLES - ALL AXES

FIGURE C-49. TEST RECORD FOR FRAGMENT NO. 49




DATE 3/29/85

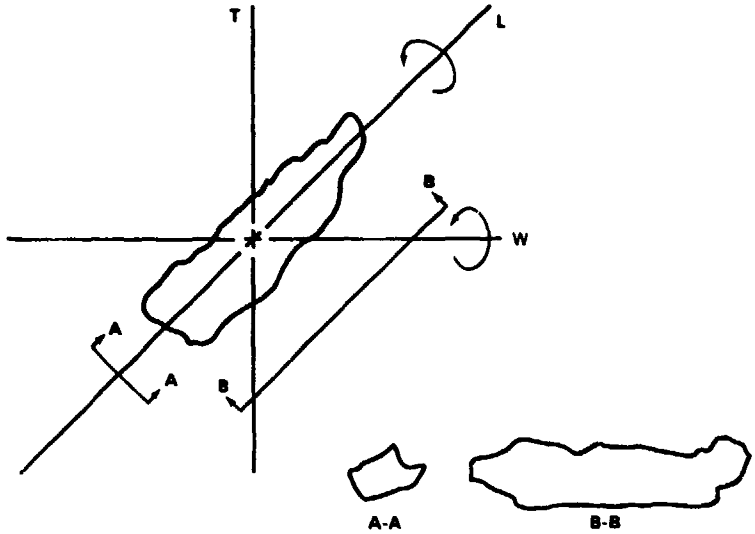
TEST NO. 210

RUN NO. 50

| FRAGMENT NUMBER | WEIGHT (lb) | AREA (ft²) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/ft³) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 50 | .05454 | .00442 | 755.2 | 75 | .002291 | 98.7 | 1.10577 |

COMMENTS: ROTATES AROUND T - FLAT SPIN

FIGURE C-50. TEST RECORD FOR FRAGMENT NO. 50




DATE 4/1/85

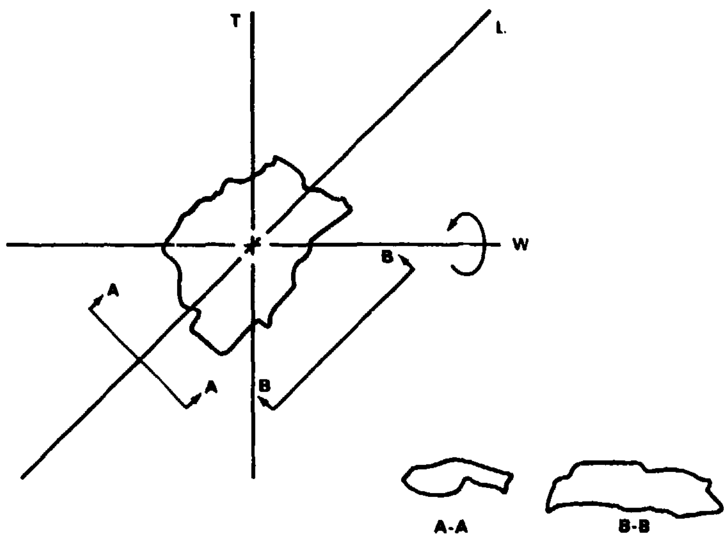
TEST NO. 210

RUN NO. 51

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 51 | .05574 | .00543 | 752.5 | 54 | .002376 | 90.6 | 1.05268 |

COMMENTS: ROTATES AROUND L AND W AND CONING

FIGURE C-51. TEST RECORD FOR FRAGMENT NO. 51




DATE 4/1/85

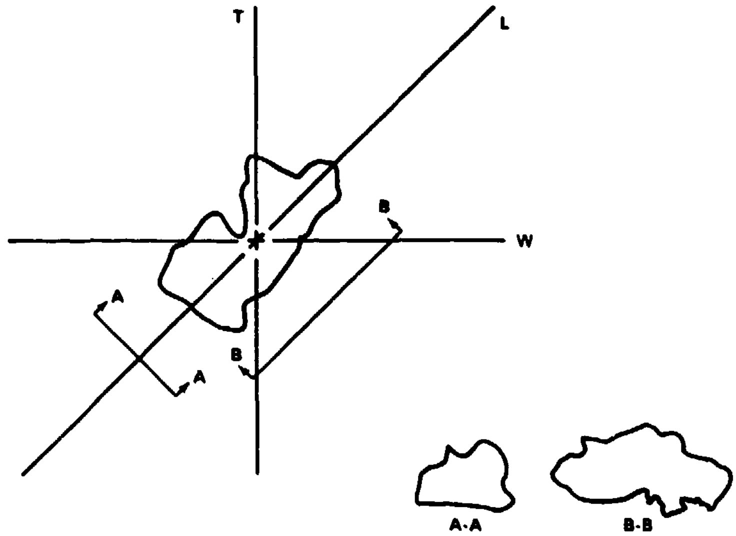
TEST NO. 210

RUN NO. 52

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 52 | .05619 | .00532 | 752.5 | 54 | .002376 | 87.4 | 1.16388 |

COMMENTS: FLAT SPIN

FIGURE C-52. TEST RECORD FOR FRAGMENT NO. 52




DATE 4/1/85

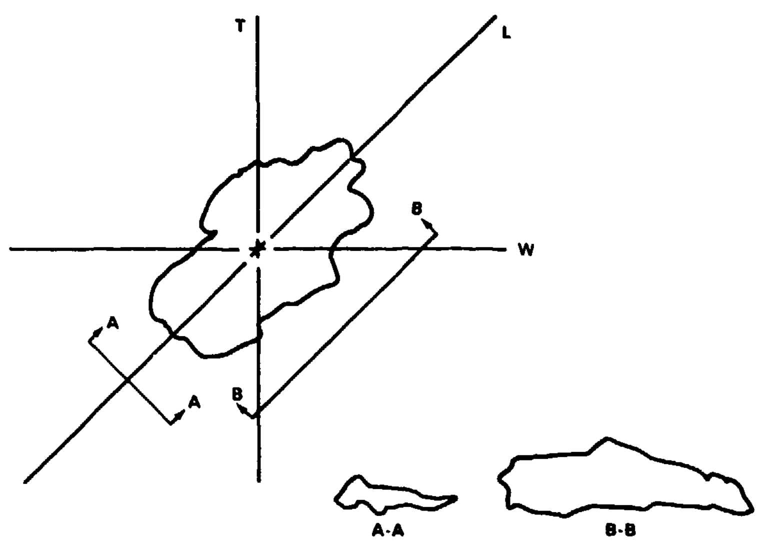
TEST NO. 210

RUN NO. 53

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 53 | .05644 | .00520 | 752.5 | 54 | .002376 | 109.9 | .75644 |

COMMENTS: ROTATES AROUND ALL AXES AND TUMBLES

FIGURE C-53. TEST RECORD FOR FRAGMENT NO. 53




DATE 4/1/85

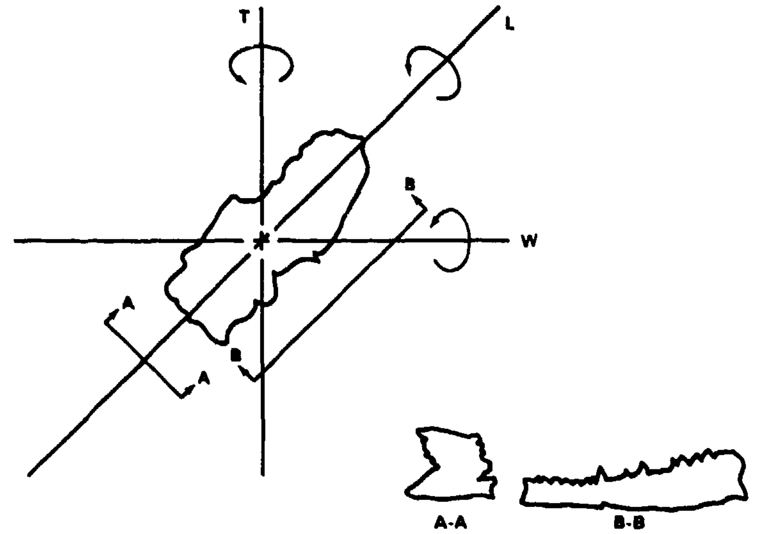
TEST NO. 210

RUN NO. 54

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 54 | .0578 | .00667 | 752.5 | 54 | .002376 | 81 | 1.11177 |

COMMENTS: FLUTTERS LIKE A FALLING LEAF

FIGURE C-54. TEST RECORD FOR FRAGMENT NO. 54




DATE 4/1/85

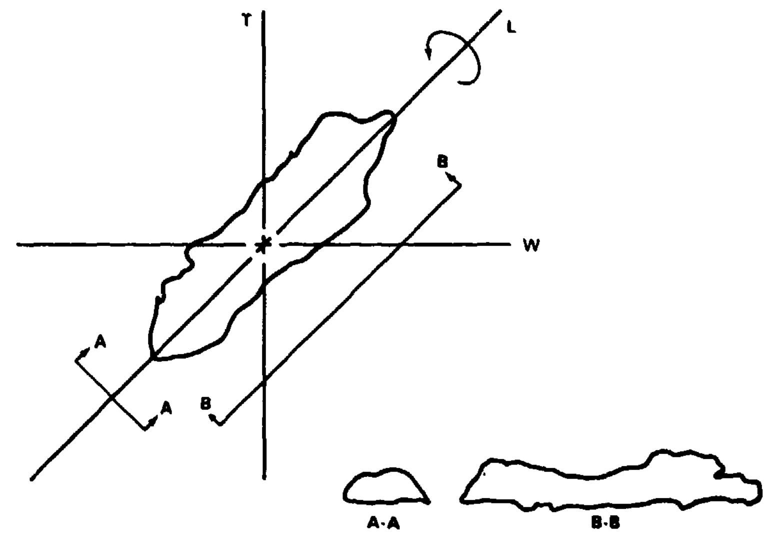
TEST NO. 210

RUN NO. 55

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 55 | .06181 | .00588 | 752.5 | 54 | .002376 | 100.3 | .87956 |

COMMENTS: ALL AXES - TUMBLES

FIGURE C-55. TEST RECORD FOR FRAGMENT NO. 55




DATE 4/1/85

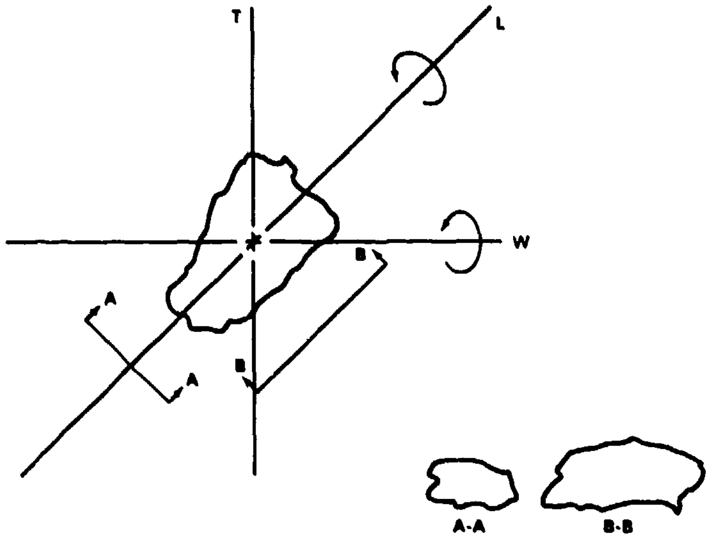
TEST NO. 210

RUN NO. 56

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 56 | .06513 | .00649 | 752.5 | 54 | .002376 | 90.6 | 1.02911 |

COMMENTS: ROTATES AROUND L AND FLOATS MOTIONLESS

FIGURE C-56. TEST RECORD FOR FRAGMENT NO. 56




DATE 4/1/85

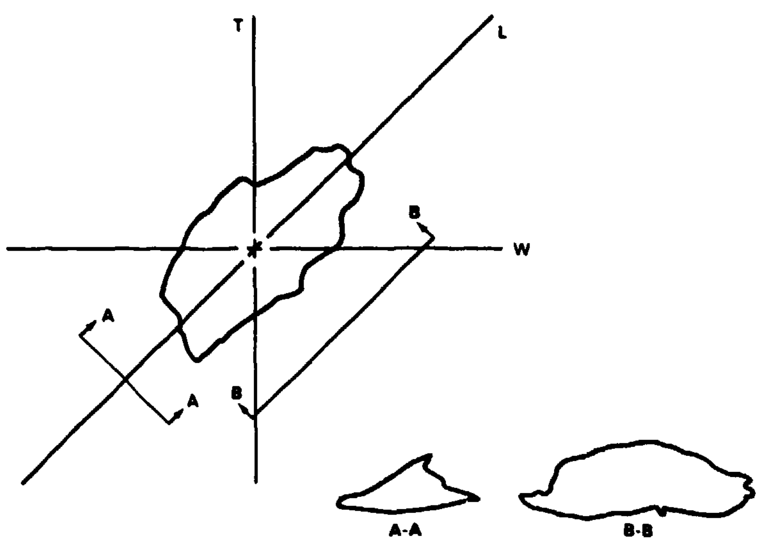
TEST NO. 210

RUN NO. 57

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 57 | .06596 | .00510 | 752.5 | 54 | .002376 | 118.0 | .78186 |

COMMENTS: ROTATES AROUND L AND W AND TUMBLES

FIGURE C-57. TEST RECORD FOR FRAGMENT NO. 57




DATE 4/1/85

TEST NO. 210

RUN NO. 58

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 58 | .0664 | .00607 | 752.5 | 54 | .002376 | 90.6 | 1.12178 |

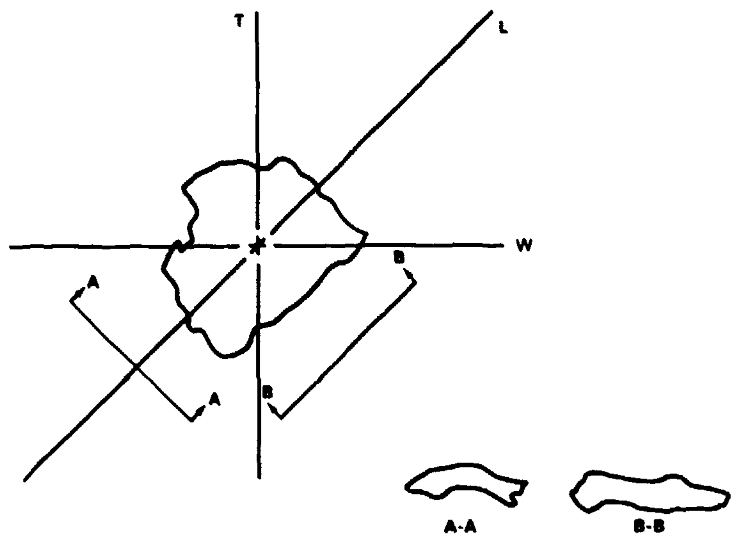
COMMENTS: WITH THE FLAT SIDE DOWN AS SHOWN IN A-A - THE FRAG FLOATS; WITH THE FLAT SIDE UP (OR ON TOP) THE FRAG DOES A FLAT SPIN

FIGURE C-58. TEST RECORD FOR FRAGMENT NO. 58

DATE 4/1/85

TEST NO. 210

RUN NO. 59




| FRAGMENT NUMBER | WEIGHT (lb) | AREA (ft²) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/ft³) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 59 | .06903 | .00642 | 752.5 | 54 | .002376 | 93.8 | 1.02868 |

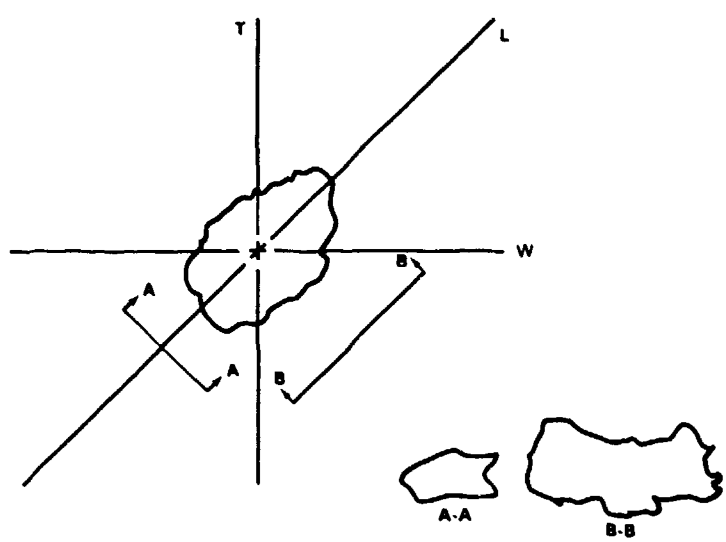
COMMENTS: ROTATES AROUND T AND L AND FLAT SPIN

FIGURE C-59. TEST RECORD FOR FRAGMENT NO. 59

DATE 4/1/85

TEST NO. 210

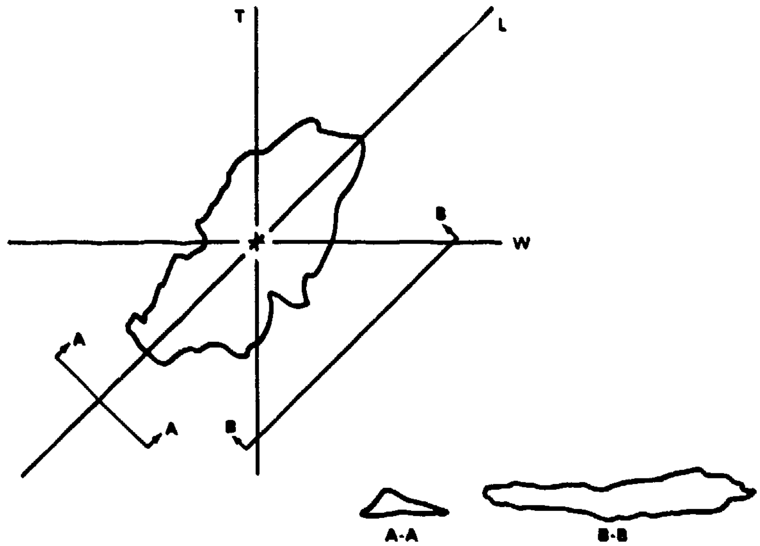
RUN NO. 60




| FRAGMENT NUMBER | WEIGHT (lb) | AREA (ft²) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/ft³) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 60 | .06916 | .00507 | 752.5 | 54 | .002376 | 113.1 | .8976 |

COMMENTS: ROTATES AROUND T - FLAT SPIN

FIGURE C-60. TEST RECORD FOR FRAGMENT NO. 60




DATE 4/1/85

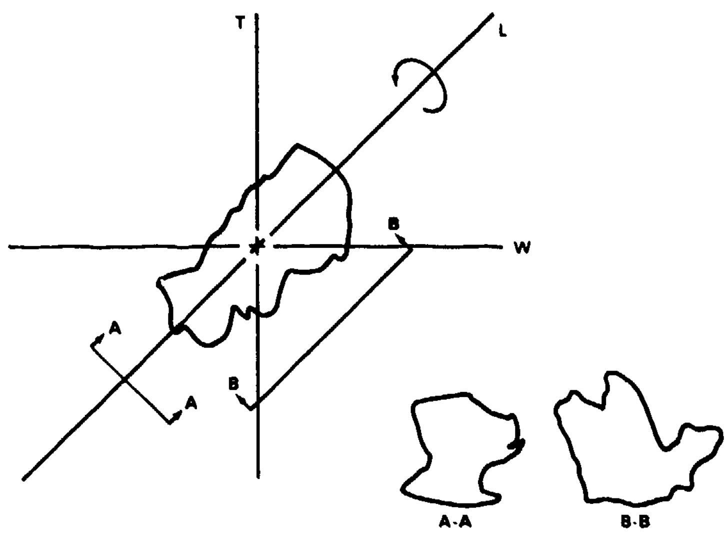
TEST NO. 210

RUN NO. 61

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 61 | .06953 | .00716 | 752.5 | 55 | .002372 | 92.2 | .96319 |

COMMENTS: ROTATES AROUND ALL 3 AXES AND FLAT

FIGURE C-61. TEST RECORD FOR FRAGMENT NO. 61




DATE 4/1/85

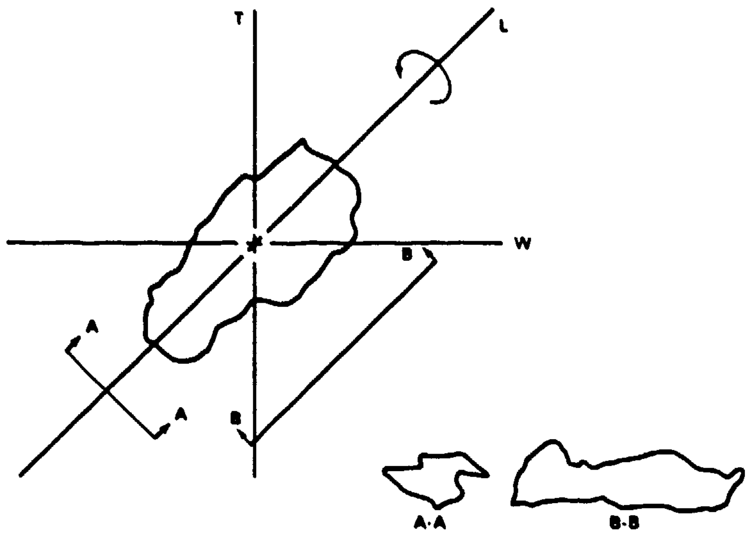
TEST NO. 210

RUN NO. 62

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 62 | .0699 | .00597 | 752.5 | 55 | .002372 | 116.4 | .72864 |

COMMENTS: ROTATES AROUND L AND GOOD TUMBLE

FIGURE C-62. TEST RECORD FOR FRAGMENT NO. 62




DATE 4/1/85

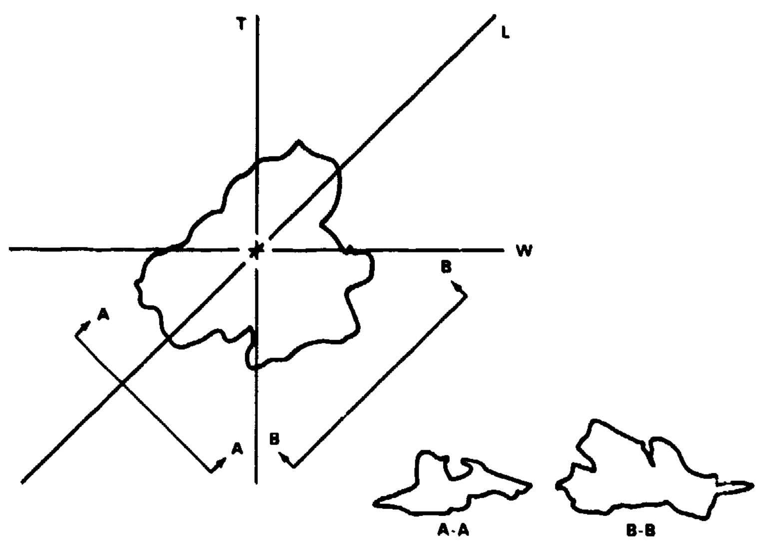
TEST NO. 210

RUN NO. 63

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 63 | .07013 | .00643 | 752.5 | 55 | .002372 | 103.5 | .85847 |

COMMENTS: FLAT SPIN OR TUMBLE

FIGURE C-63. TEST RECORD FOR FRAGMENT NO. 63




DATE 4/1/85

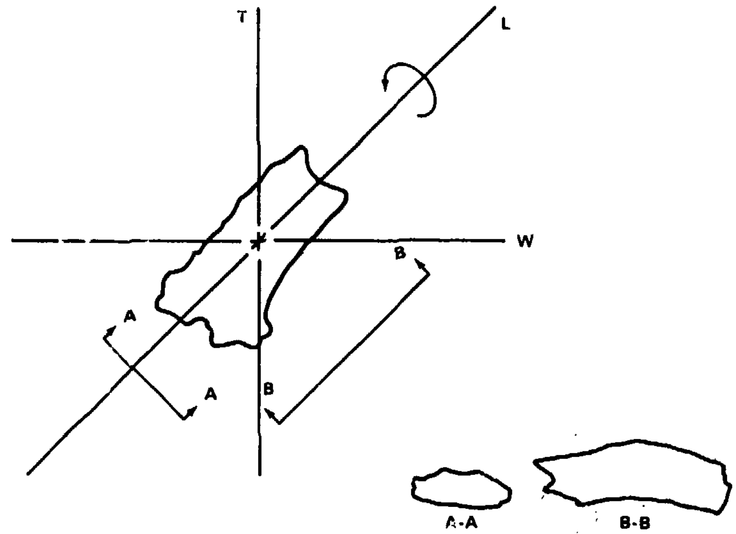
TEST NO. 210

RUN NO. 64

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 64 | .07073 | .00797 | 752.5 | 55 | .002372 | 92.2 | .88024 |

COMMENTS: WILL FLOAT OR TUMBLE

FIGURE C-64. TEST RECORD FOR FRAGMENT NO. 64




DATE 4/1/85

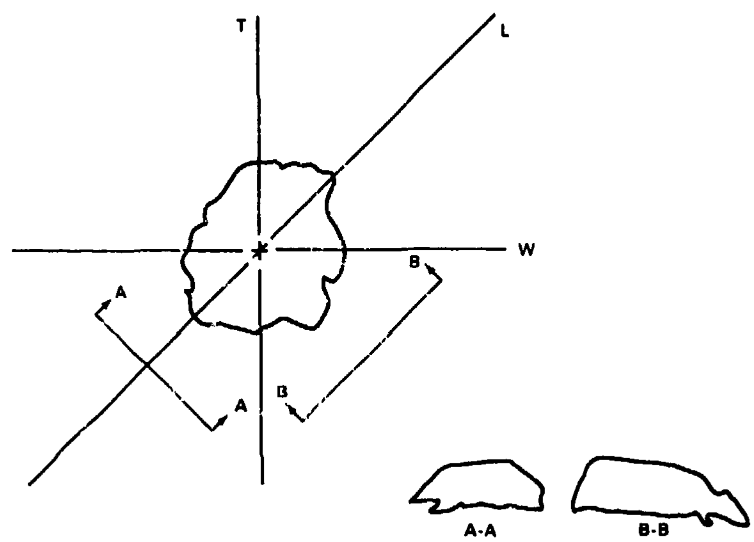
TEST NO. 210

RUN NO. 65

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 65 | .07214 | .00552 | 752.5 | 55 | .002372 | 113. | .86144 |

COMMENTS: WILL FLOAT MOTIONLESS OR TUMBLE

FIGURE C-65. TEST RECORD FOR FRAGMENT NO. 65




DATE 4/1/85

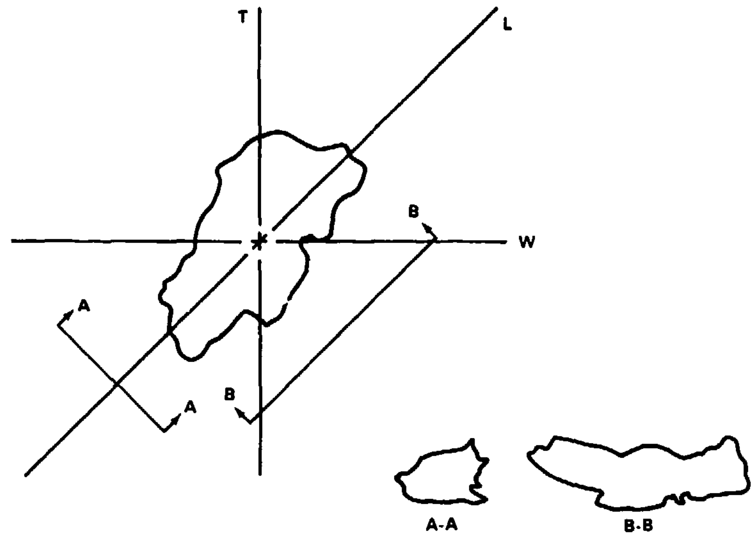
TEST NO. 210

RUN NO. 66

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 66 | .07423 | .00588 | 752.5 | 56 | .002367 | 100.3 | 1.06031 |

COMMENTS: FLOAT - SLOW OR NO ROTATION AROUND THE T AXIS

FIGURE C-66. TEST RECORD FOR FRAGMENT NO. 66




DATE 4/1/85

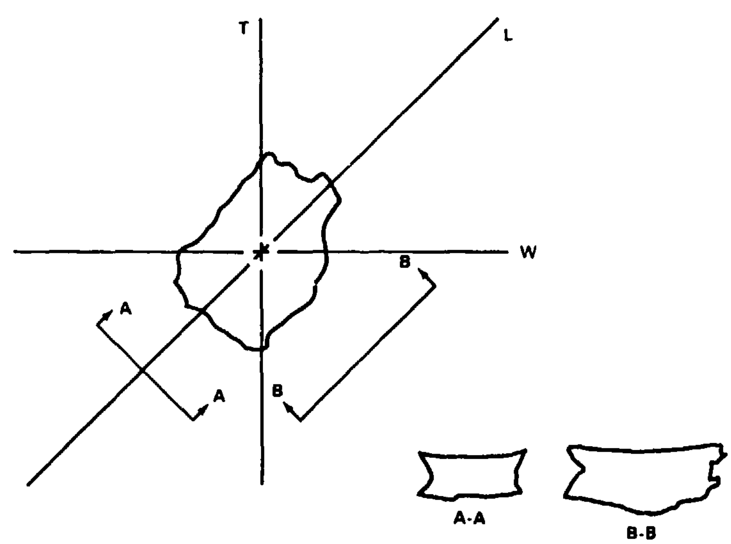
TEST NO. 210

RUN NO. 67

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 67 | .07599 | .0067382 | 752.5 | 56 | .002367 | 101.9 | .91769 |

COMMENTS: FLAT SPIN OR WILL FLOAT

FIGURE C-67. TEST RECORD FOR FRAGMENT NO. 67




DATE 4/1/85

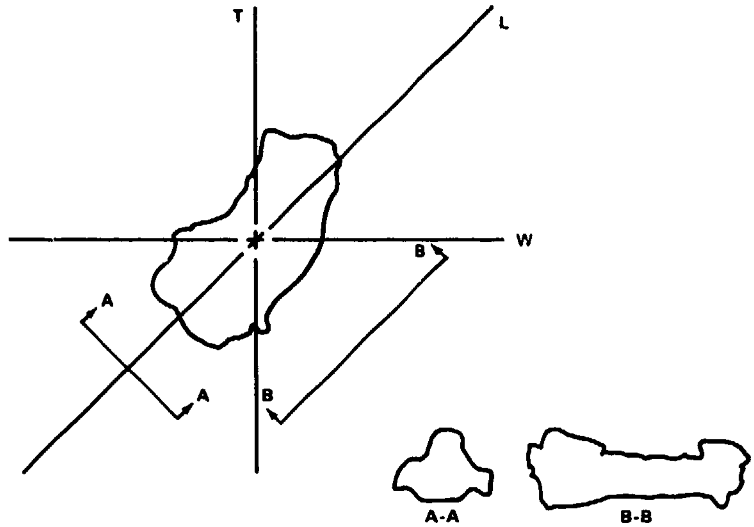
TEST NO. 210

RUN NO. 68

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 68 | .07827 | .00595 | 752.3 | 58 | .002357 | 109.9 | .92417 |

COMMENTS: WILL FLOAT MOTIONLESS OR GO INTO A FLAT SPIN

FIGURE C-68. TEST RECORD FOR FRAGMENT NO. 68




DATE 4/1/85

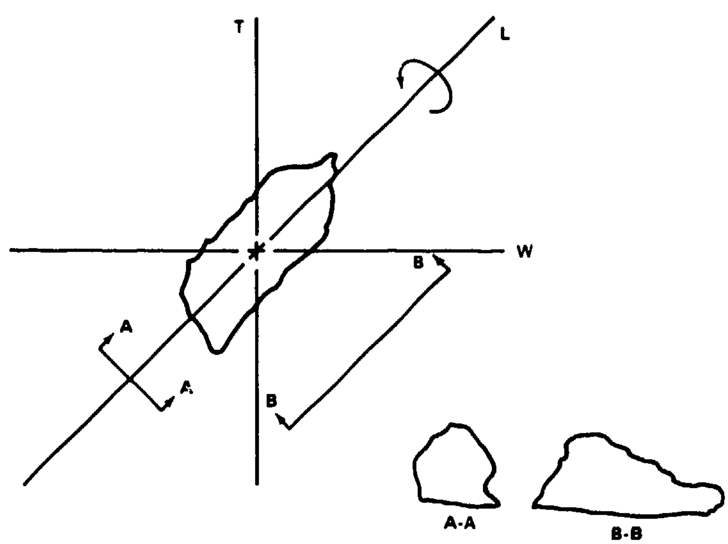
TEST NO. 210

RUN NO. 69

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 69 | .07946 | .00639 | 752.3 | 58 | .002357 | 109.9 | .87362 |

COMMENTS: WILL TUMBLE AND CONING AROUND L AXIS

FIGURE C-69. TEST RECORD FOR FRAGMENT NO. 69




DATE 4/1/85

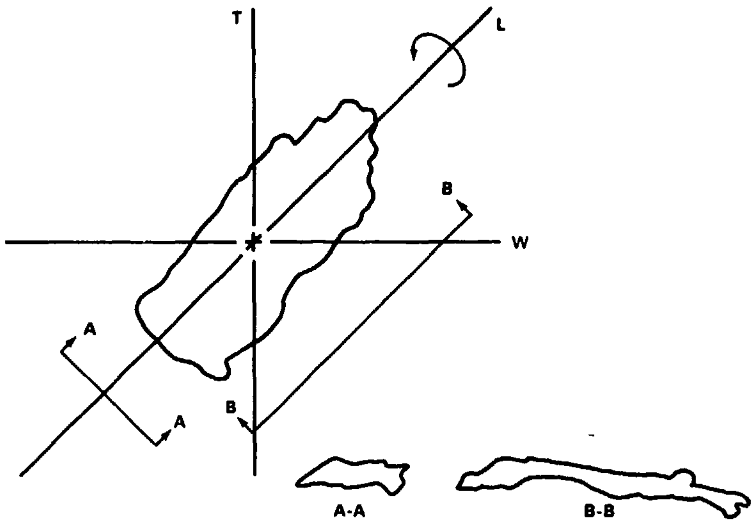
TEST NO. 210

RUN NO. 70

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 70 | .08017 | .00521 | 752.3 | 58 | .002357 | 135.6 | .71011 |

COMMENTS: ROTATES AROUND L AXIS AND TUMBLES

FIGURE C-70. TEST RECORD FOR FRAGMENT NO. 70




DATE 4/1/85

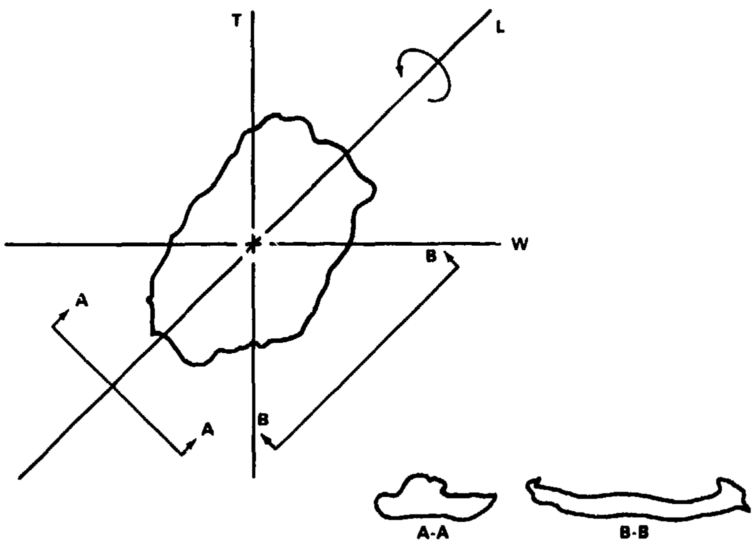
TEST NO. 210

RUN NO. 71

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 71 | .08691 | .00800 | 752.3 | 58 | .002357 | 97.1 | .97771 |

COMMENTS: ROTATES AROUND L AXIS AND CONING

FIGURE C-71. TEST RECORD FOR FRAGMENT NO. 71




DATE 4/1/85

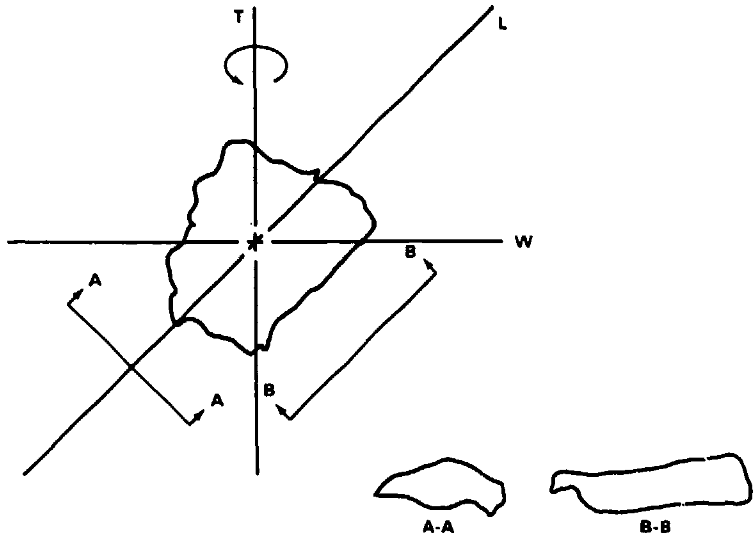
TEST NO. 210

RUN NO. 72

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 72 | .0931 | .00876 | 752.3 | 58 | .002357 | 98.7 | .92572 |

COMMENTS: FLOATS MOTIONLESS, ROTATES AROUND L AXIS AND TUMBLES

FIGURE C-72. TEST RECORD FOR FRAGMENT NO. 72




DATE 4/1/85

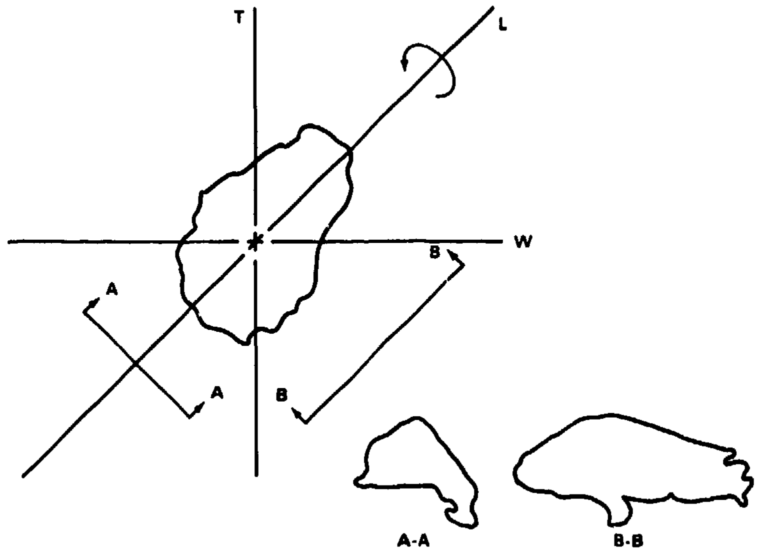
TEST NO. 210

RUN NO. 73

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 73 | .09363 | .00738 | 752.2 | 57 | .002362 | 113.1 | .83981 |

COMMENTS: FLAT SPIN AND FLOATS MOTIONLESS

FIGURE C-73. TEST RECORD FOR FRAGMENT NO. 73




DATE 4/1/85

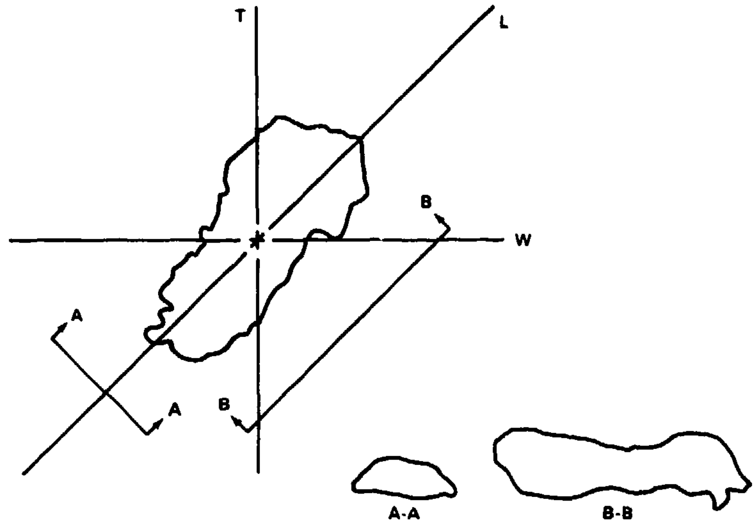
TEST NO. 210

RUN NO. 74

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 74 | .09371 | .00701 | 752.2 | 57 | .002362 | 114.7 | .86038 |

COMMENTS: ROTATES AROUND L AND WILL TUMBLE

FIGURE C-74. TEST RECORD FOR FRAGMENT NO. 74




DATE 4/1/85

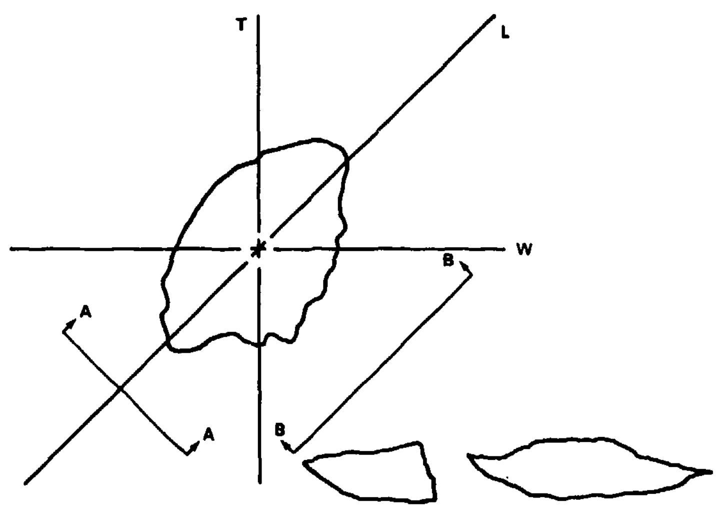
TEST NO. 210

RUN NO. 75

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 75 | .0955 | .00764 | 752.2 | 57 | .002362 | 103.5 | .98805 |

COMMENTS: LITTLE BIT OF EVERYTHING - ROLL, TUMBLE, CONE

FIGURE C-75. TEST RECORD FOR FRAGMENT NO. 75




DATE 4/1/85

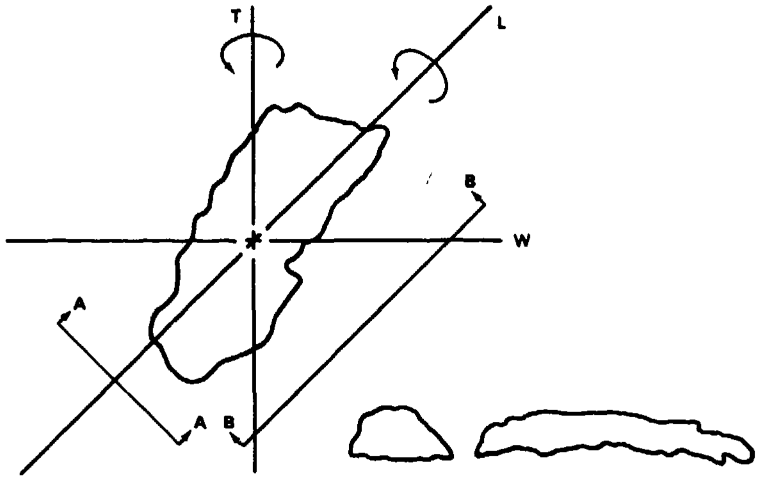
TEST NO. 210

RUN NO. 76

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 76 | .10198 | .00792 | 751.4 | 60 | .002392 | 113.1 | .84165 |

COMMENTS: ROTATES AND TUMBLES IN ALL DIRECTIONS

FIGURE C-76. TEST RECORD FOR FRAGMENT NO. 76




DATE 4/1/85

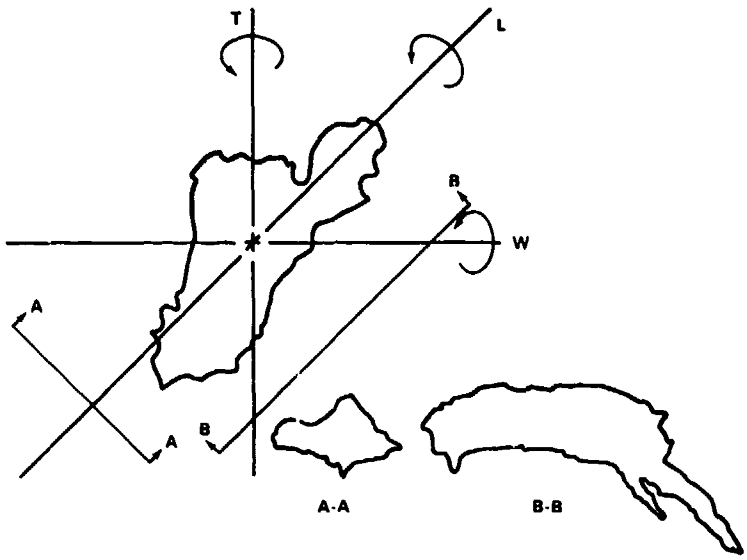
TEST NO. 210

RUN NO. 77

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 77 | .10273 | .00810 | 751.4 | 50 | .002392 | 90.6 | 1.29151 |

COMMENTS: FLAT SPIN (LIKE A PROPELLER) WILL ROTATE AROUND THE L AXIS ALSO

FIGURE C-77. TEST RECORD FOR FRAGMENT NO. 77




DATE 4/1/85

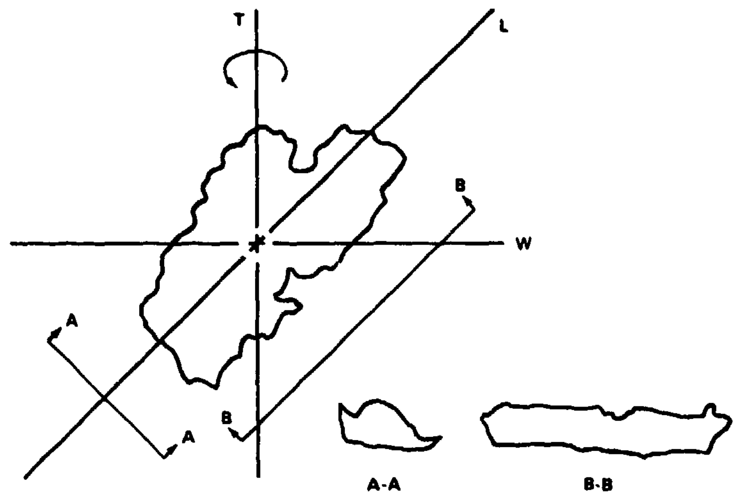
TEST NO. 210

RUN NO. 78

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 78 | .10957 | .00899 | 751.4 | 50 | .002392 | 106.7 | .8953 |

COMMENTS: ROTATES AROUND ALL 3 AXES AND CONING

FIGURE C-78. TEST RECORD FOR FRAGMENT NO. 78




DATE 4/1/85

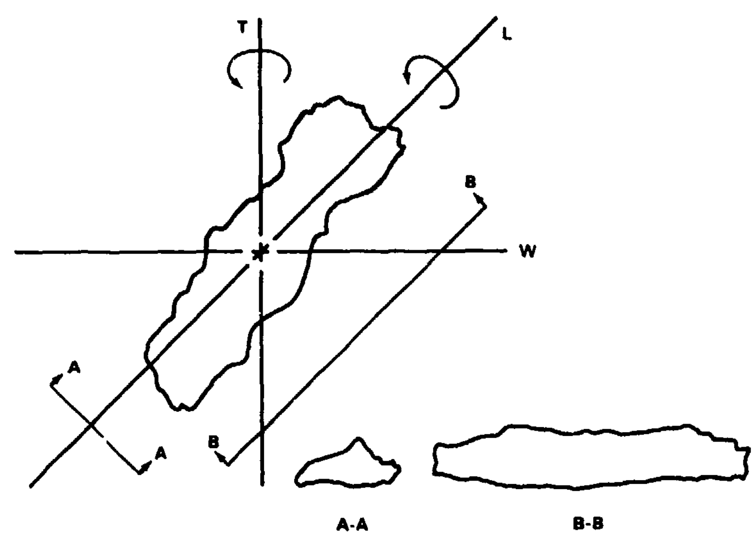
TEST NO. 210

RUN NO. 79

| FRAGMENT NUMBER | WEIGHT (lb) | AREA (ft²) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/ft³) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 79 | .11096 | .00901 | 751 | 54 | .002372 | 89 | 1.31092 |

COMMENTS: FLAT SPIN AROUND T

FIGURE C-79. TEST RECORD FOR FRAGMENT NO. 79




DATE 4/1/85

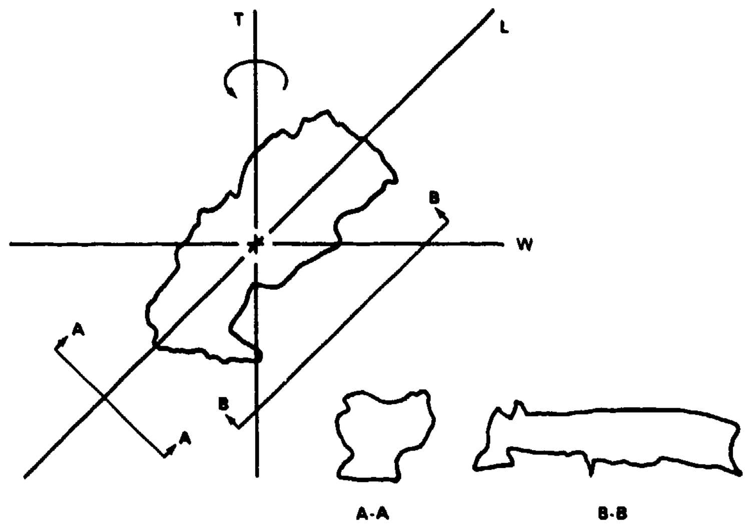
TEST NO. 210

RUN NO. 80

| FRAGMENT NUMBER | WEIGHT (lb) | AREA (ft²) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/ft³) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 80 | .111 | .00860 | 751 | 54 | .002372 | 106.7 | .95590 |

COMMENTS: ROTATES AROUND L AND T

FIGURE C-80. TEST RECORD FOR FRAGMENT NO. 80




DATE 4/1/85

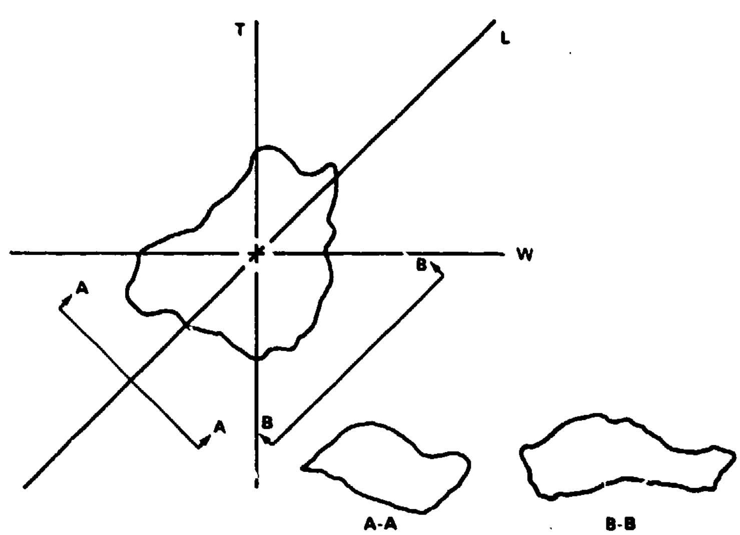
TEST NO. 210

RUN NO. 81

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 81 | .11174 | .00834 | 751 | 54 | .002372 | 106.7 | .99227 |

COMMENTS: FLAT SPIN AROUND T

FIGURE C-81. TEST RECORD FOR FRAGMENT NO. 81




DATE 4/1/85

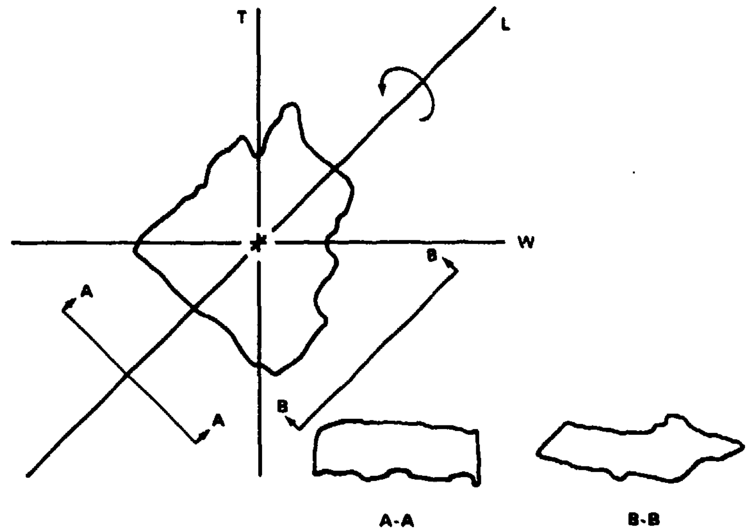
TEST NO. 210

RUN NO. 82

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 82 | .11497 | .00753 | 750.6 | 54 | .002370 | 126.0 | .81158 |

COMMENTS: TUMBLES AROUND ALL AXES

FIGURE C-82. TEST RECORD FOR FRAGMENT NO. 82




DATE 4/1/85

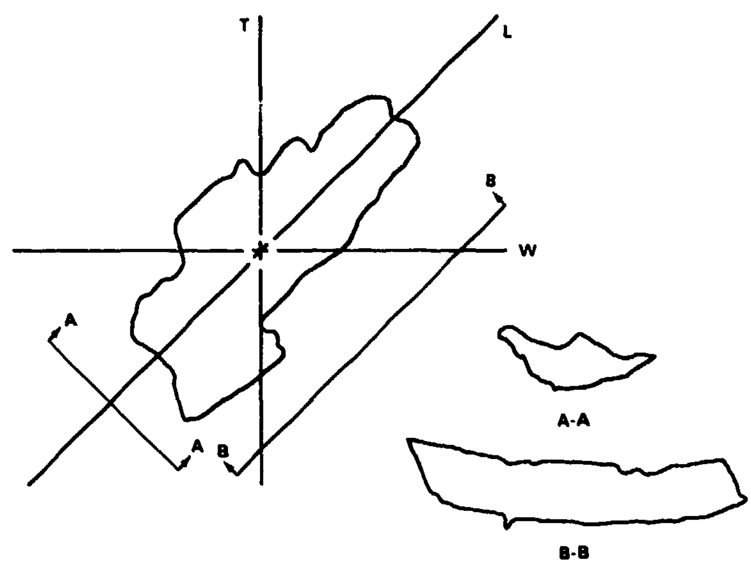
TEST NO. 210

RUN NO. 83

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 83 | .1191 | .00879 | 750.6 | 54 | .002370 | 113.1 | .89388 |

COMMENTS: ROTATES AROUND L AND TUMBLES

FIGURE C-83. TEST RECORD FOR FRAGMENT NO. 83




DATE 4/1/85

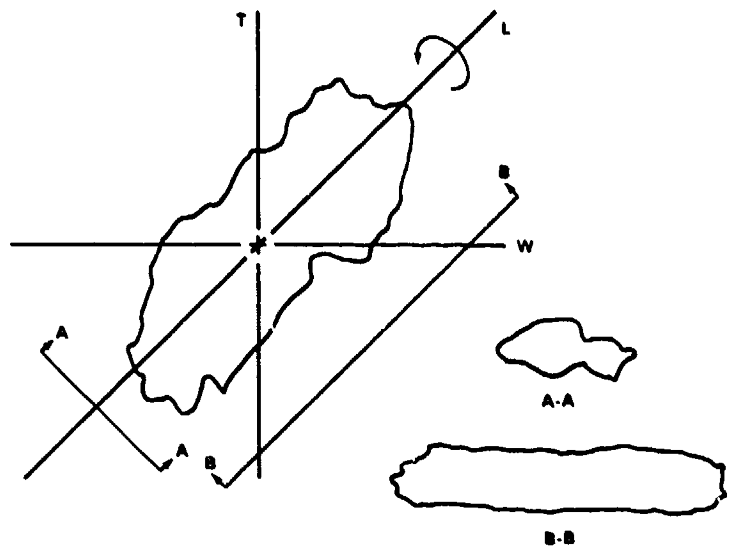
TEST NO. 210

RUN NO. 84

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 84 | .12376 | .00976 | 750.6 | 54 | .002370 | 103.5 | .99924 |

COMMENTS: LOOKED LIKE A FLOATING LEAF TO START AND THEN WENT INTO A FLAT SPIN

FIGURE C-84. TEST RECORD FOR FRAGMENT NO. 84




DATE 4/1/85

TEST NO. 210

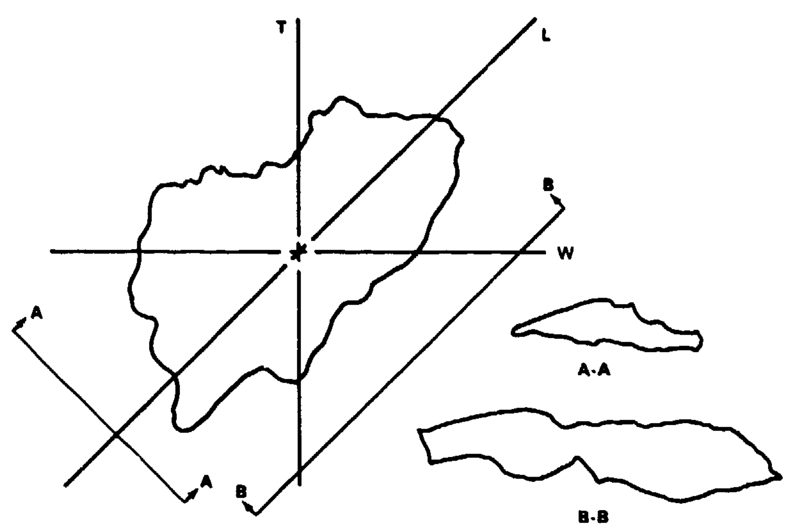
RUN NO. 85

| FRAGMENT NUMBER | WEIGHT (lb) | AREA (ft$^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/ft$^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 85 | .2311 | .0139409 | 750.5 | 53 | .002375 | 122.8 | .92572 |

COMMENTS: ROTATES AROUND L AND A FLAT SPIN

*FRAGMENT INFORMATION FOR NUMBERS 85 THRU 96 WAS TAKEN FROM TABLE A-2

FIGURE C-85. TEST RECORD FOR FRAGMENT NO. 85




DATE 4/1/85

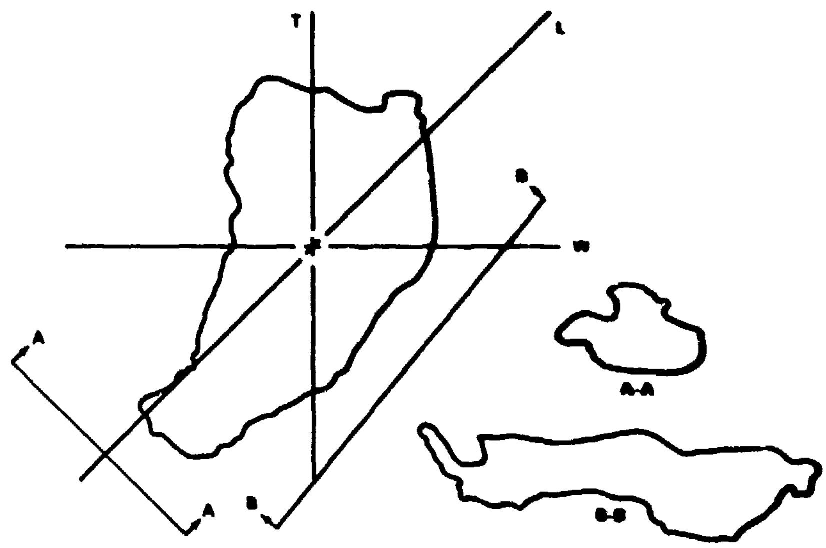
TEST NO. 210

RUN NO. 86

| FRAGMENT NUMBER | WEIGHT (lb) | AREA (ft$^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/ft$^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 86 | .23583 | .0170312 | 750.5 | 53 | .002375 | 97.1 | 1.23674 |

COMMENTS: FLAT SPIN AND WOULD ALSO FLOAT MOTIONLESS

FIGURE C-86. TEST RECORD FOR FRAGMENT NO. 86




DATE 4/1/85

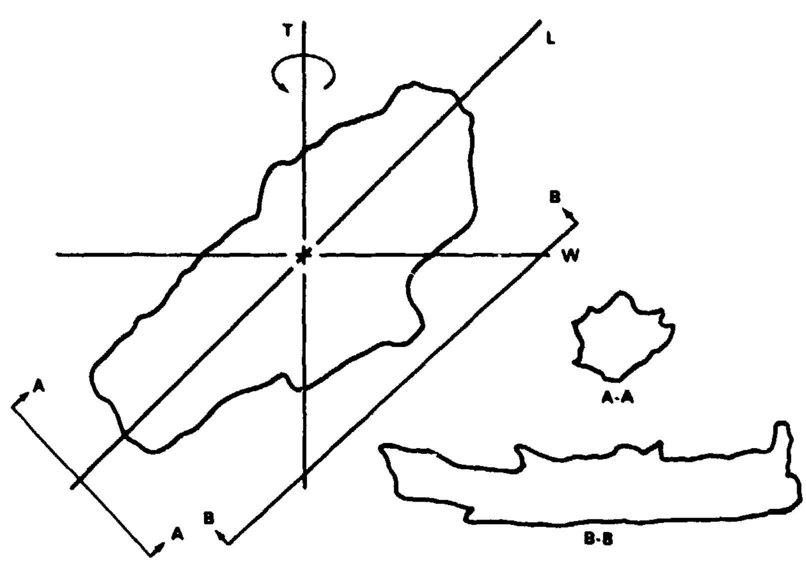
TEST NO. 210

RUN NO. 87

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 87 | .25706 | .0173281 | 750.5 | 53 | .002376 | 113.1 | .97882 |

COMMENTS: TUMBLES AND FLAT SPIN AROUND T

FIGURE C-87. TEST RECORD FOR FRAGMENT NO. 87

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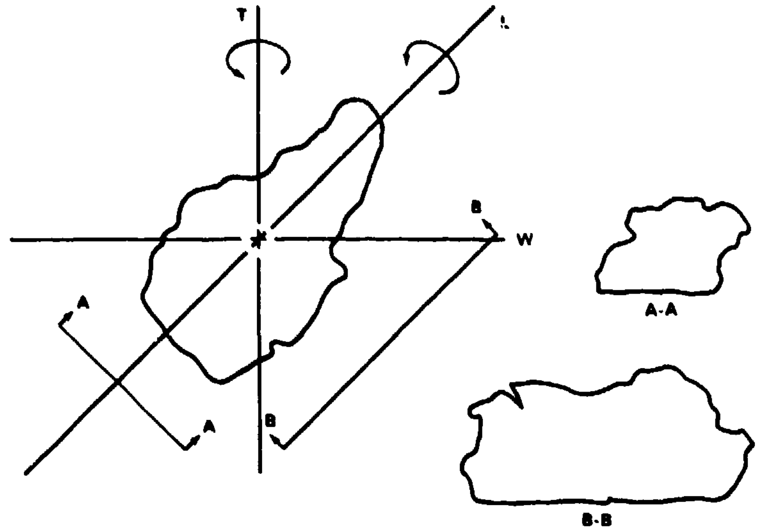
TEST NO. 210

RUN NO. 88

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/$ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 88 | .28189 | .019618 | 750.5 | 54 | .002370 | 113.1 | .94794 |

COMMENTS: FLAT SPIN AROUND T

FIGURE C-88. TEST RECORD FOR FRAGMENT NO. 88




DATE 4 1 85

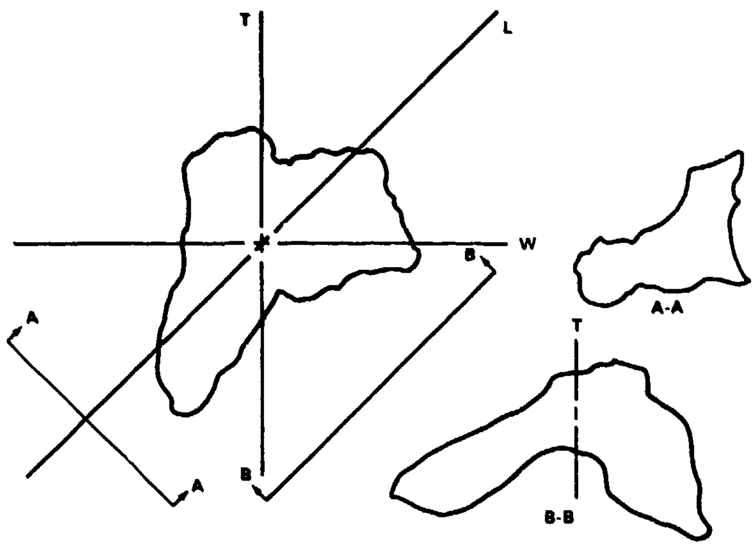
TEST NO 210

RUN NO 89

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 89 | .28863 | .013126 | 750.5 | 54 | .002370 | 151.7 | .80054 |

COMMENTS ROTATES AROUND T AND L

FIGURE C-89. TEST RECORD FOR FRAGMENT NO. 89

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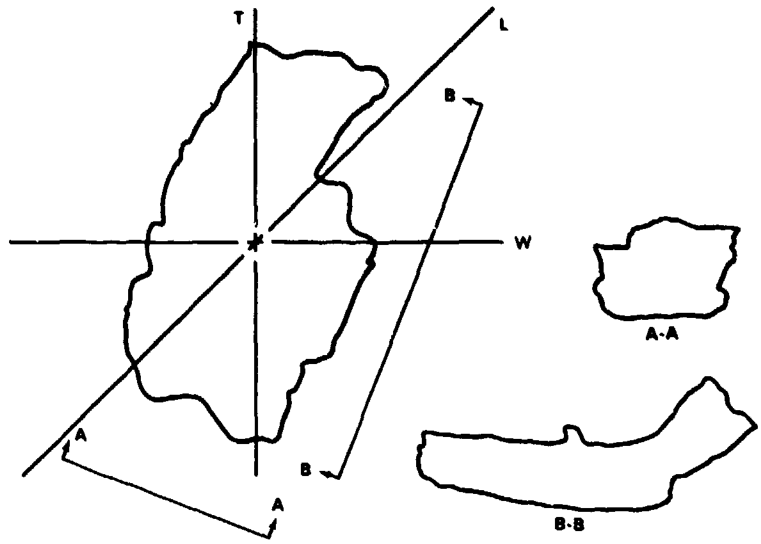
TEST NO. 210

RUN NO. 90

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 90 | .2866 | .0133152 | 750.5 | 54 | .002370 | 151.7 | .78929 |

COMMENTS: SPIN AROUND T AND TUMBLES

FIGURE C-90. TEST RECORD FOR FRAGMENT NO. 90

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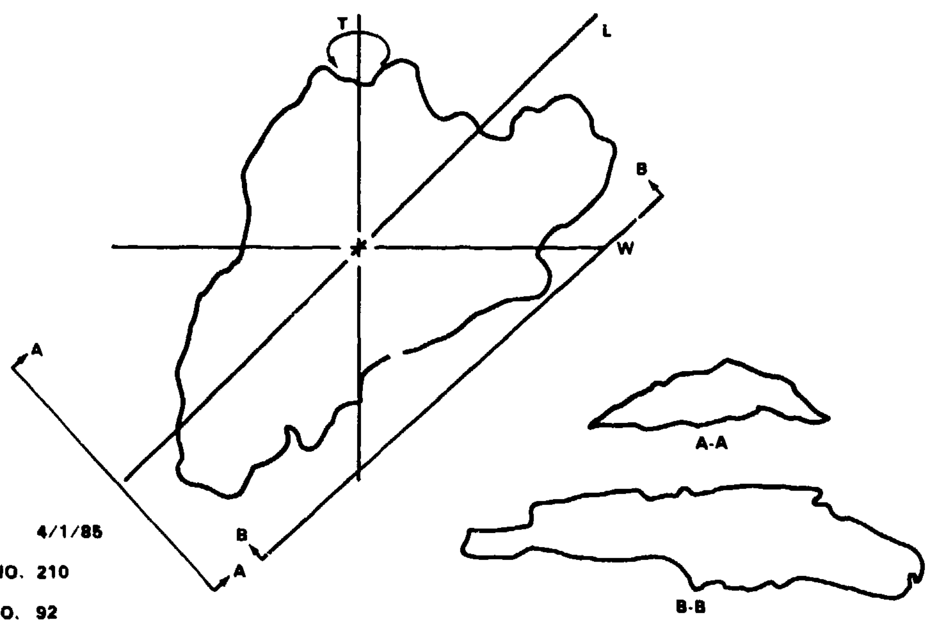
TEST NO. 210

RUN NO. 91

| FRAGMENT NUMBER | WEIGHT (lb) | AREA (ft²) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/ft³) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 91 | .2908 | .0183263 | 750.0 | 54 | .002369 | 116.4 | .98873 |

COMMENTS: FLAT SPIN AND FLOATS MOTIONLESS

FIGURE C-91. TEST RECORD FOR FRAGMENT NO. 91

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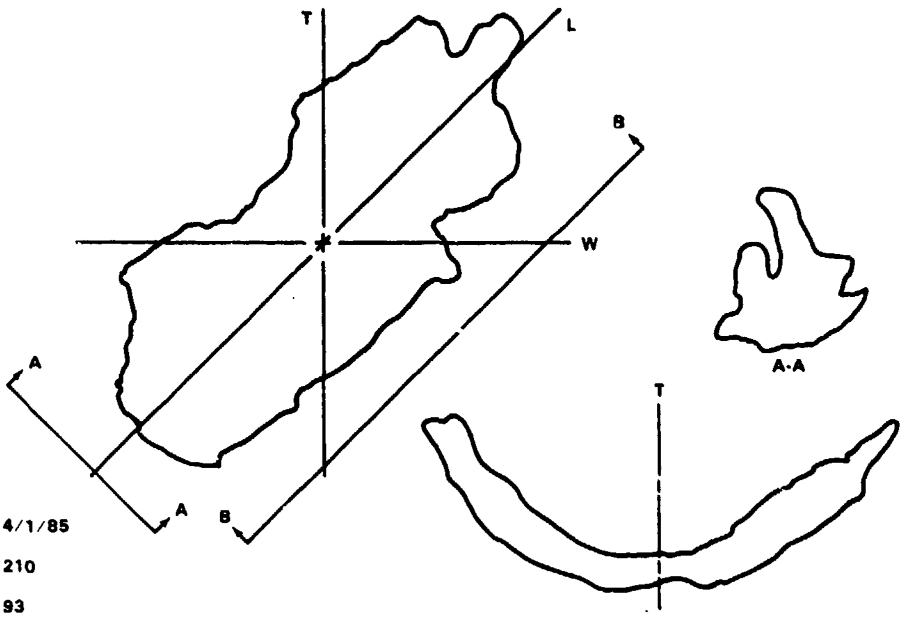
TEST NO. 210

RUN NO. 92

| FRAGMENT NUMBER | WEIGHT (lb) | AREA (ft²) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/ft³) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 92 | .39476 | .0267458 | 750.0 | 54 | .002369 | 93.8 | 1.41624 |

COMMENTS: GOOD FLAT SPIN AROUND T

FIGURE C-92. TEST RECORD FOR FRAGMENT NO. 92

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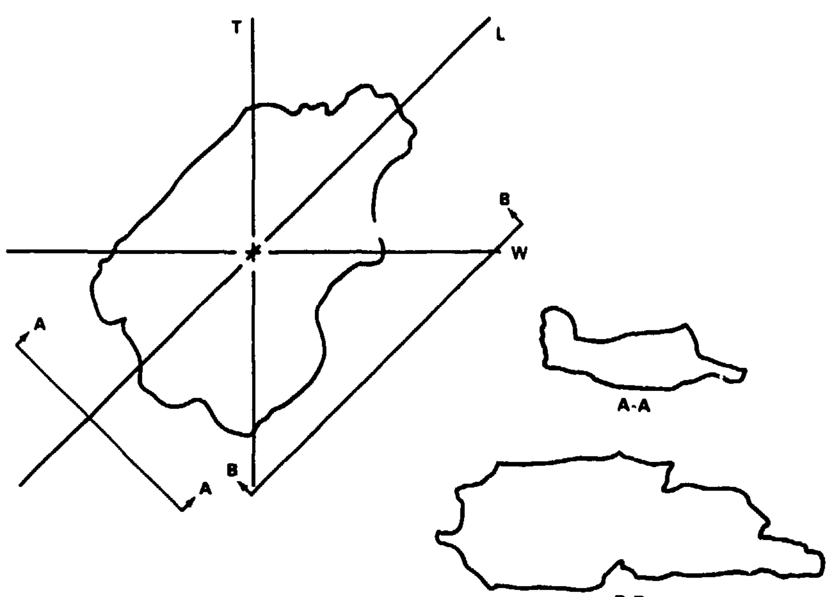
TEST NO. 210

RUN NO. 93

| FRAGMENT NUMBER | WEIGHT (lb) | AREA (ft$^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/ft$^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 93 | .4497 | .0263708 | 750 | 54 | .002369 | 119.6 | 1.00647 |

COMMENTS: ROTATES AROUND T

FIGURE C-93. TEST RECORD FOR FRAGMENT NO. 93

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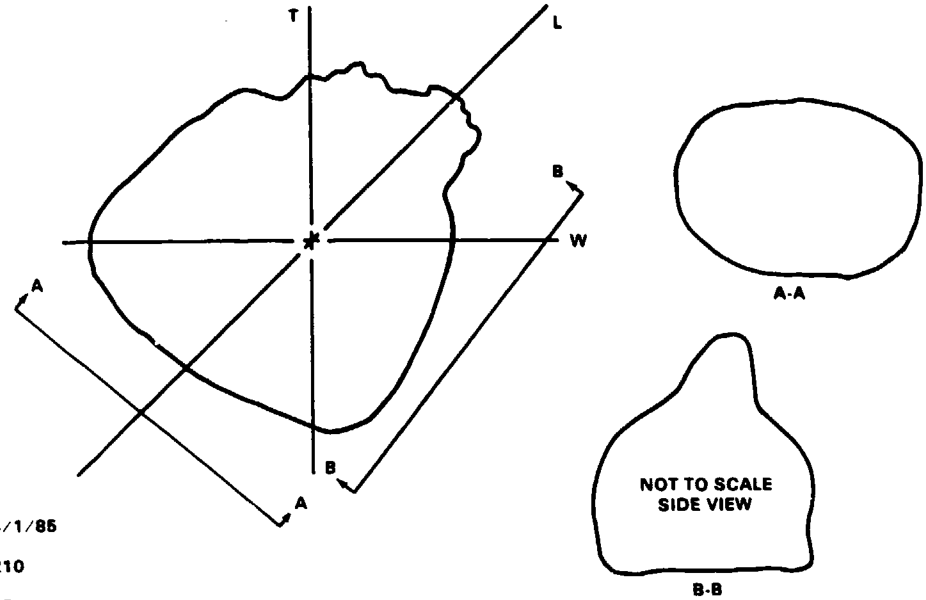
TEST NO. 210

RUN NO. 94

| FRAGMENT NUMBER | WEIGHT (lb) | AREA (ft$^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY (SLUG/ft$^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 94 | .46831 | .0201888 | 750 | 54 | .002369 | 138.9 | 1.01502 |

COMMENTS: ROTATES ANY DIRECTION AND TUMBLES

FIGURE C-94. TEST RECORD FOR FRAGMENT NO. 94




DATE 4/1/85

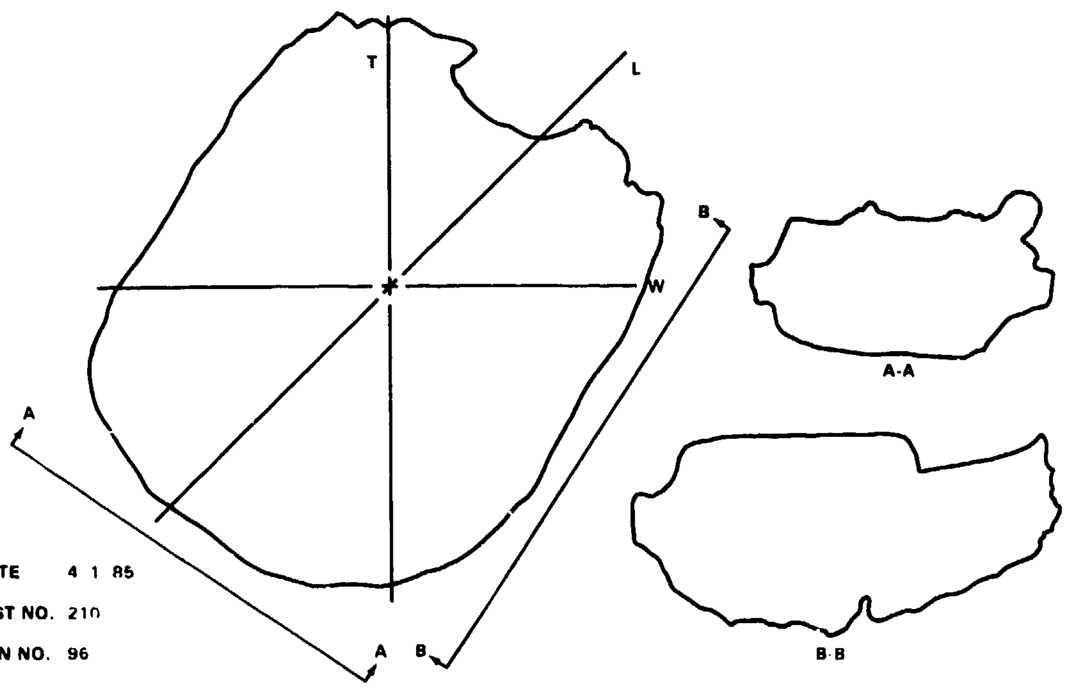
TEST NO. 210

RUN NO. 95

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 95 | 2.22787 | .0440173 | 750.0 | 54 | .002369 | 293.2 | .49706 |

COMMENTS: THIS FRAGMENT WOULD FLOAT MOTIONLESS

FIGURE C-95. TEST RECORD FOR FRAGMENT NO. 95




DATE 4 1 85

TEST NO. 210

RUN NO. 96

| FRAGMENT NUMBER | WEIGHT (lb) | AREA ($ft^2$) | PRESS (Hg-mm) | TEMP (deg F) | DENSITY ($SLUG/ft^3$) | VELOCITY (ft/s) | CD |
|---|---|---|---|---|---|---|---|
| 96 | 3.34478 | .0714333 | 750 | 54 | .002369 | 200 | .98827 |

COMMENTS: ROTATES AROUND T AXIS

FIGURE C-96. TEST RECORD FOR FRAGMENT NO. 96

# APPENDIX D

# CATEGORIES OF FRAGMENT MOTION

The fragment motions in the wind tunnel given in the COMMENTS of test records of Appendix C were divided in eight categories in an attempt at further correlation with the drag coefficients. The eight categories together with their associated fragments are given in Figures D-1 through D-8.

The eight categories are listed as follows:

1. Random Tumbling,
2. Floats Motionless,
3. Flat Rotation,
4. Rotates about L & T axes,
5. Rotates about L & W axes,
6. Rotates around T axis,
7. Rotates around the L axes,
8. Coning

The L, W and T axes are those given in the test records of Appendix C. When two axes are given for the motion, the fragments will rotate about either at different times. The difference between flat rotation and rotates around the T axis is that rotation around the T axis involves much more wobble than flat rotation. Flat rotation is also about the T axis.

Coning can be explained by imagining a thin rod held fixed at its center. One end of the rod is then moved to describe a circle such that the half rod length sweeps out a cone with apex at the fixed center. As a result the other half of the rod also sweeps out a cone with its apex also at the fixed center. Viewed from the side, it would appear to be something like a bow tie.

Below each fragment plan view, there are two numbers. The first is the fragment number given in Appendix C; second, in parenthesis, is the low subsonic drag coefficient obtained from the vertical wind tunnel tests.

This appendix, together with Appendixes A, B and C give a good idea of both the shape and size of the fragments.

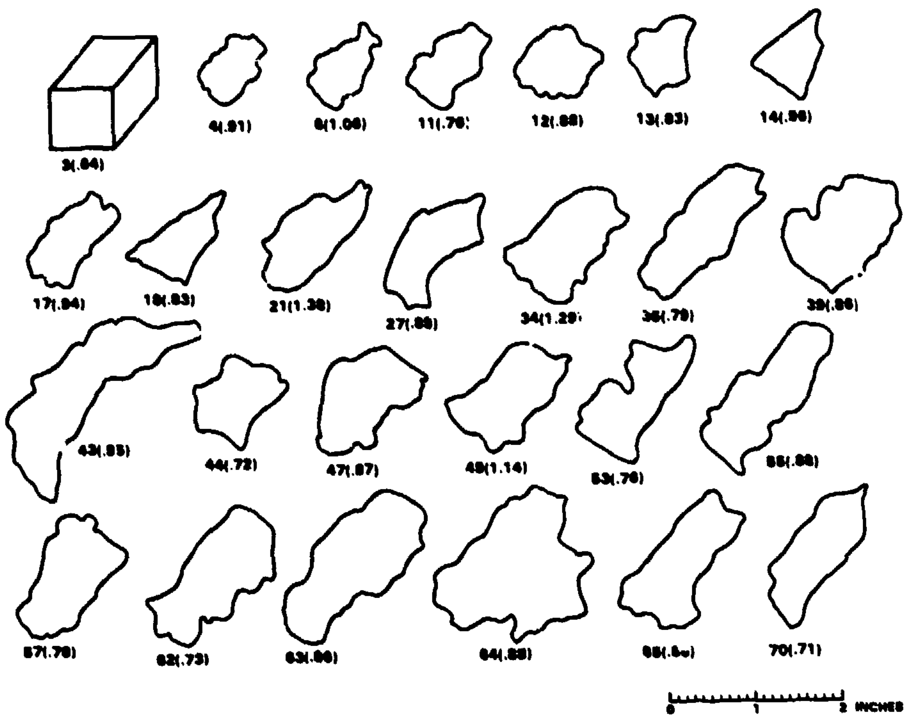


FIGURE D-1. RANDOM TUMBLING

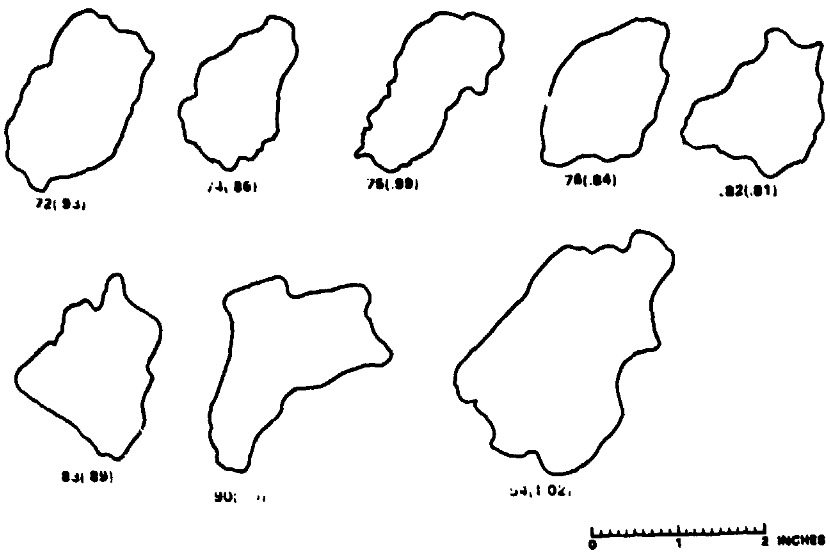


FIGURE D-1. RANDOM TUMBLING (Continued)

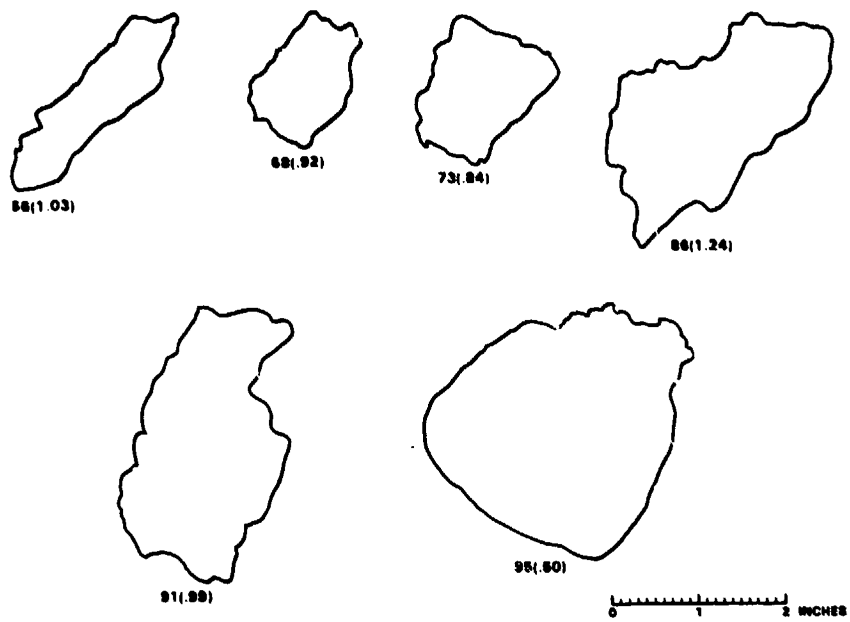
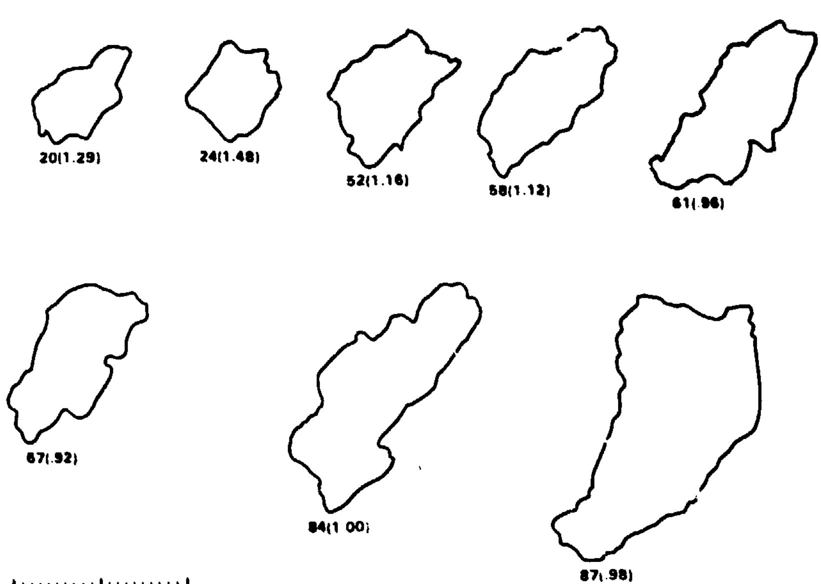



FIGURE D-2. FLOATS MOTIONLESS




FIGL RE D-3. FLAT ROTATION

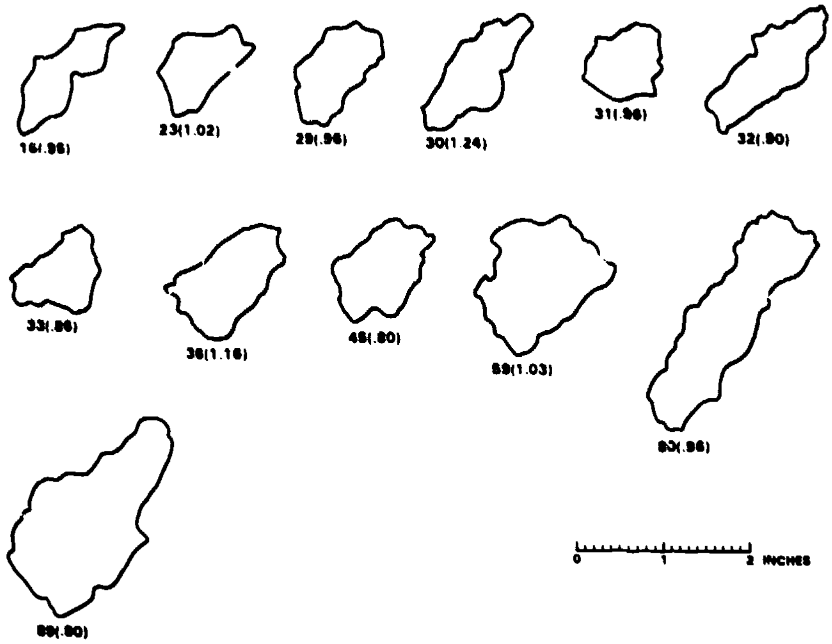



FIGURE D-4. ROTATES ABOUT THE L AND T AXIS

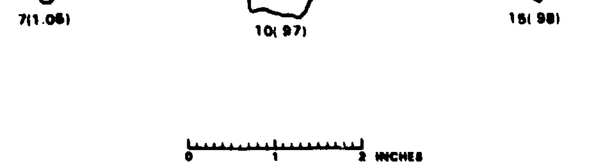



FIGURE D-5. ROTATES ABOUT THE L AND W AXIS

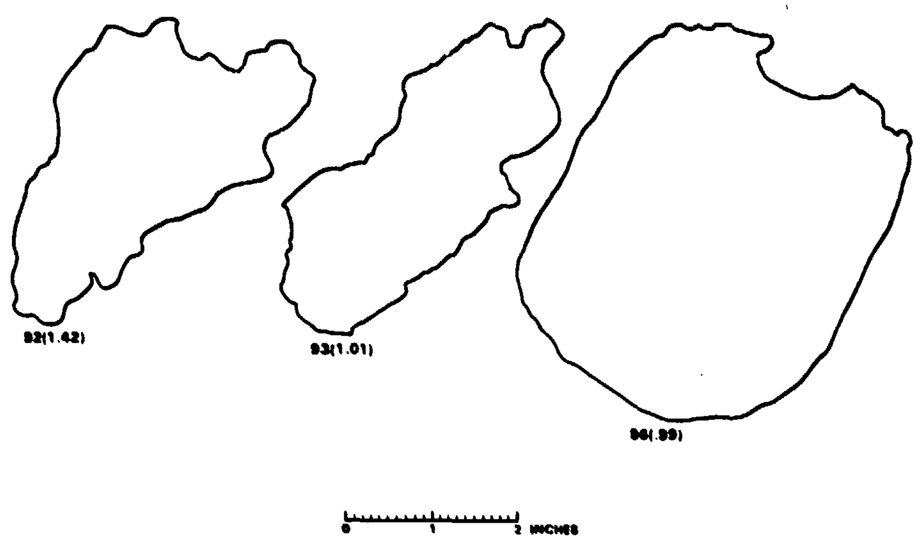



**FIGURE D-6. ROTATES AROUND THE T-AXIS**

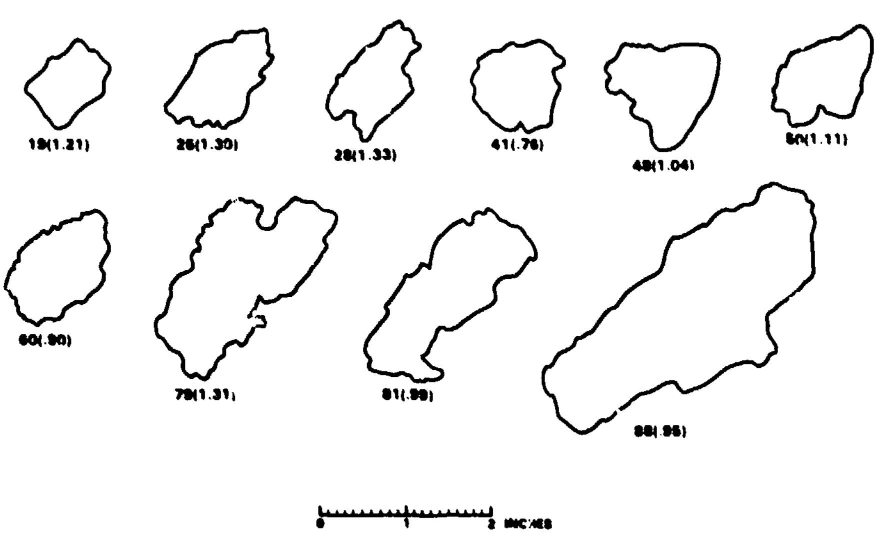



**FIGURE D-6. ROTATES AROUND THE T-AXIS (Continued)**

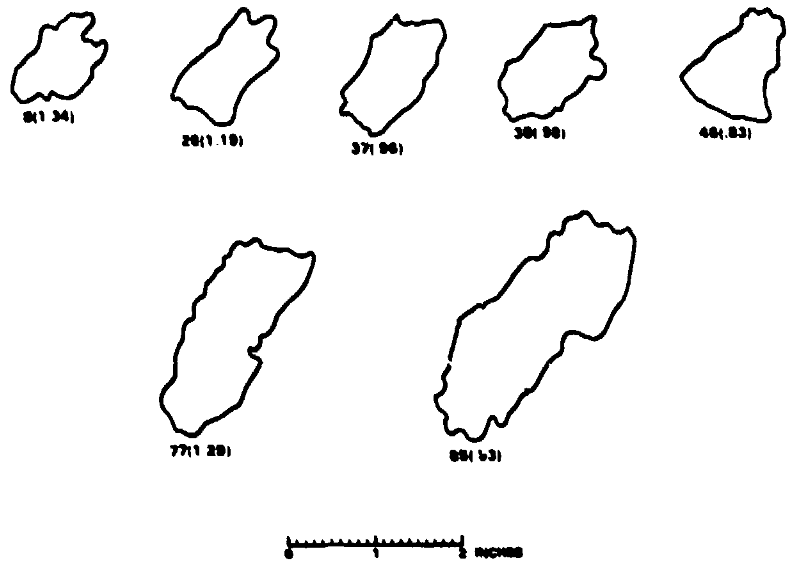


FIGURE D-7. ROTATES AROUND THE L-AXIS

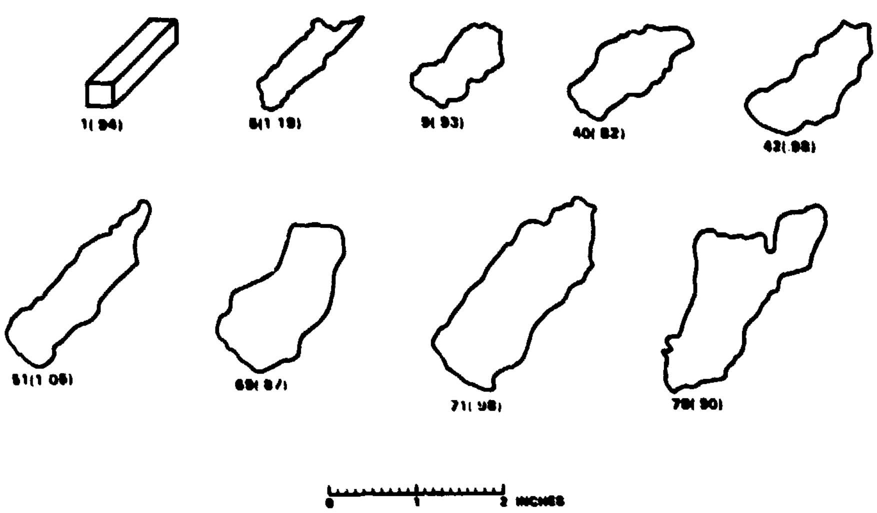


FIGURE D-8. CONING

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